Bones and Identity

Zooarchaeological Approaches to Reconstructing Social and Cultural Landscapes in Southwest Asia

Edited by
Nimrod Marom
Reuven Yeshurun
Lior Weissbrod
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Front cover: Wild sheep skull from the osteological collection of the Laboratory of Archaeozoology, Zinman Institute of Archaeology, University of Haifa. Photography and cover design by Anat Regev-Gisis.

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Introduction: Animal Bones and Cultural Identity in the Archaeology of Southwest Asia

Nimrod Marom, Reuven Yeshurun, Lior Weissbrod and Guy Bar-Oz

The concept of "Bones and Identity" – applying the toolbox of archaeozoology to the reconstruction of socio-cultural diversity in antiquity – offers an especially powerful integrating theme in the archaeozoology of southwest Asia. This region boasts a long and intensely researched sequence of cultural evolution, especially between the rise of early sedentary hamlets to that of empires, and forms one of the world's hot-spots of archaeological research, beginning more than 150 years ago. Here, in particular, the endeavour to attach a "face" and a "name" to the material remains which are studied by archaeologists has long served as a catalyst for devising methods to detect the presence of discrete socio-cultural groups and reconstruct their respective economies, politics and environments from specific material fingerprints.

In recent decades, animal remains have emerged as one of the more promising approaches to the exploration and systematic study of socio-cultural identity as expressed through ancient practices of meat consumption – a universal human activity which has always bound together considerations of ecology, economy, social class, religion, and ethnicity and has relevance for investigating different sections of ancient societies. Unlike many other categories of ancient material culture, animal remains reflect simultaneously patterns of subsistence, politics, and self-identification and provide researchers with particularly rich repositories of data.

Bones and Identity was chosen by us as the leading theme for the 11th Meeting of the Archaeozoology of Southwest Asia and Adjacent Regions held at the University of Haifa in June 2013. This volume, providing the proceedings for the conference, brings together 17 papers written by archaeozoologists working mainly in southwest Asia, but also in neighbouring regions between Greece in the west and India in the east. Its temporal scope spans the Paleolithic to the Middle Ages, providing an overview of the conceptual and methodological approaches employed to tackle complex issues of diversity and identity in social systems – an especially challenging task for practitioners which often work as collaborators in excavation projects lacking an explicit research design focused on these questions. The papers in this volume present a realistic notion of what can be accomplished through a "Bones and Identity"-oriented archaeozoological research programme as well as of the limitations of such research within the framework of projects carried out in southwest Asia.

The volume – arranged in chronological order – opens with a chapter by Yeshurun who provides an outline of the long history of archaeozoological research at the Paleolithic sites of Mount Carmel (Israel), demonstrating the shift from paleontologically-oriented work in the early 20th century to one

focused on paleo-economic interpretations beginning in the 1980s. Current research in this region deals with a diversity of issues spanning that of long-term faunal succession and its implications for paleo-environmental reconstruction, subsistence economy, and the organization of site use including the development of practices of garbage disposal and differential use of space – an avenue of research based on the employment of contextual taphonomy and opening the way to establishing a more fine-tuned understanding of daily activity and the human habitus, especially among Natufian societies 14.5–11.5 Ka BP. Belmaker and Brown explore interactions between these complex hunter-gatherers and species of micro-vertebrates within the anthropogenic environment. The authors advance the possibility that common mice of the genus *Mus* – often considered as commensal with humans – should instead be seen as parasites in human communities. Such mouse parasitism in early sedentarizing Natufian communities implies that active measures to eradicate pests may have been taken and adds a new dimension to our understanding of camp life beginning at the dawn of permanent settlement and continuing to this day.

Starkovich presents data dealing with the terminal Pleistocene site of Choga Golan in the Zagros region (Iran) that support a patently different model of complex hunter-gatherer economy and its role as a factor in subsequent Neolithization processes to the one developed in the Levant. Whereas in the Levant large, perennial base-camps of the Natufian culture *ca*. 15,000 BP are thought to have caused rapid resource depletion within their environment resulting in broad-spectrum economies, the Choga Golan faunal sequence lacks evidence for human pressure on subsistence resources and more extensive resource use and culminates with the gradual adoption of plant and animal domesticates. These diverging scenarios raise interesting questions regarding varying outcomes of interactions among such processes as human sedentarization and population growth, resource pressure, and intensification in resource exploitation on a trajectory to domestication and the development of agricultural economies.

Tornero and colleagues employ demographic and metric analysis of sheep remains from the 8th millennium BC site of Tell Halula (Syria) to demonstrate the *in situ* process of formation of a pastoralist economy. They bring forth evidence to the rapid and successful adoption of domesticated sheep in an economy which has already adopted other domesticates successfully. The increase in sheep frequencies in the context of a meat-oriented herd economy testifies to the plasticity of early agrarian human economic systems and their ability to incorporate novelties. These data bear far-reaching implications for change in the organization of livestock production required to accommodate a new and labour-intensive domesticate within a budding society of herders. Neolithic animal utilization is also examined by Greenfield, Cheney and Galili, addressing this question from the perspective of butchery technology at the site of Atlit Yam, a 7th millennium BC village now submerged under the Mediterranean Sea south of Haifa (Israel). The results presented in this paper show that butchery was carried out using non-retouched flint tools, illustrating the handy and immediate nature of tools of convenience employed in unspecialized animal butchery and the intricate association between this activity and formal flint tools used in the construction of chrono-cultural sequences.

Bar-Yosef examines evolving interactions among hunter-gatherer and early settled communities within the broad expanse of southwest Asia, particularly in reference to “desert kites” – a form of artificial landscape modification used as a trap for the harvesting *en masse* of wild ungulates such as the ubiquitous gazelle (*Gazella* sp.). It is suggested that following an initial waning in gazelle harvesting among early cultivating communities of the Neolithic, the demand for gazelles waxed with the growth

of agricultural communities along the major rivers of Mesopotamia. One of the critical resources for these communities came in the form of skins obtained from gazelles and used in the manufacture of floats employed in river transportation. Bar-Yosef develops a model of the nature of interactions and boundary maintenance among contemporary settled communities and persisting enclaves of hunter-gatherer, combining ethnographic knowledge and archaeological evidence to suggest the existence of such social mechanisms as intermarriage and commensality among traders.

Bartosiewicz and Pickard's papers explore the mammalian, avian and mullascan fauna from the 5th millennium site of Tell Aqab in the upper Habur region of eastern Syria. The faunal analysis identifies a trend towards economic diversification involving increased importance of hunting in the transition between the Halaf and Ubaid periods. This diversification is interpreted as the consequence of enhanced competition among different social groups expressed through diversity in dietary practices at a time when long-established political configurations of the region were under flux due to the influence of south Mesopotamian political power. The author's explicit emphasis on social factors to account for economic change during an early phase in the evolution of complex societies – an interpretive framework more commonly employed in the archaeozoology of much later periods of time in southwest Asia, presents a welcomed approach.

Greenfield, Brown, Shai and Maeir's faunal analysis of late 3rd millennium BC Tell es-Safi/Gath (Israel) brings to light dimensions of everyday life within a non-elite context of a budding urban settlement. Their reconstruction of patterns of disposal of the faunal remains suggests the accumulation of household rubbish mainly in central dumps, and only secondarily in alleyways. An absence of bone middens from the houses themselves suggested to the authors that they were abandoned in haste. The discovery of a complete skeleton of a she-ass entered as a foundation deposit for one of the houses is further suggestive of a particular social identity for the inhabitants of the excavated quarter, possibly testifying to their association with a merchant clan. Kunst, Böhm and Czichon stress parallel concerns on the context of deposition and sociocultural practices in their analysis of the fauna from Oymaağaç Höyük, Turkey.

Hadjikoumis' study of the practice of cynophagy in broadly-contemporary (3rd millennium BC) Attica (Greece) demonstrates the practice of dog-eating, suggesting that it was employed by certain sections of society as a strategy to express a distinct identify and elevate their social standing at the *supra*-household level. The complex "social choreography" involved in the practice of cynophagy – described here for the first time among emerging complex societies of the Early Bronze Age Aegean – is reconstructed through the combination of intra-site comparisons and the consideration of detailed contextual information. Hadjekoumis' insights into the role of particular practices of animal consumption in promoting identity formation among early urban societies are echoed in Deshpande-Mukherjee's study on the rising economic and symbolic significance of cattle during the early and mature phases of the Harappan Bhirrana culture in the Ghaggar region of northern India, intricately combining contextual archaeological data and the faunal evidence. A similar emphasis on symbolism prevails in Menasaryan's discussion on animal burials in Armenia.

Greenfield and Brown's analysis of the butchery patterns observed on the animal bones from 3rd millennium BC Tell Halif, in the northern boundary of the Negev Desert in Israel, unravels gradual intensification in the use of metal and its incorporation in the manufacturing of everyday devices. At a later 2nd millennium BCE phase at the site, the authors find widespread employment of metal in animal

butchery, and identify the persisting *ad hoc* employment of flint for butchery tasks through to late Ottoman times. This methodological approach provides an original means through which to trace the availability of metal for tool manufacture and use and assess the long-term resilience of cultural traditions and the "ways of doing things" by analysing the faunal record.

Much later in time, processes of identity formation expressed through animal exploitation are analysed in a Roman period Egyptian site at the Dakhleh Oasis are examined by Crabtree and Campana. Romanization of the upper sections of society is observed in the consumption of pork which is contrasted with of the persistence and resilience of more traditional local foodways found among middle-class households. Yet another study examining ethnic identity under Roman Rule is that of Bouchnik, comparing butchery practices and assessing the issue of *kosher* butchery among late Second Temple period faunal assemblages representing the municipal garbage dump of Jerusalem and the site of the reclusive Qumran Jewish cult of the Dead Sea. Evidence is put forward for the adherence of both the residents of urban Jerusalem and rural Qumran to the *kashrut* codes of purity, with the puzzling exception of the practice of *nikur* – removal of the sciatic nerve – for which butchery marks are absent at both locations.

A final chapter by Ktalav presents a fascinating discussion on the significance of Christian pilgrim badges made of sea shells in the Middle Ages is based on a survey of archaeomalacological evidence from Israel. The study elucidates clues to the social status and gender of pilgrims, identifies the existence of "serial pilgrimages", and discovers that counterfeit trade in badges related to the Santiago de Compostela pilgrimage was practiced in the 12th and 13th centuries AD. The unique application of mollusc shell archaeology integrated with historical data provides an excellent window through which the lives of the medieval faithful can be observed.

From the above overview of research presented in this volume we can conclude that questions of identity have percolated into common practice among faunal analysts, spanning different analytical levels, from the analysis of a particular deposit at a single site to that of broader regional and/or temporal syntheses. There are preliminary signs that phenomena hitherto viewed purely through the lens of human ecology, for example, the development of broad-spectrum economies, may in the near future become subject to interpretation within broader frameworks also incorporating considerations of sociological processes relating to identity establishment in the context of inter-community boundary-setting and differentiation. Well-established classical approaches to prehistoric research are increasingly being supplemented by an appreciation of the faunal remains as representatives of the day-to-day naturalized cultural environment, reflecting the attitudes of prehistoric hunter-gatherers to garbage pests and perhaps even smells. Much later in time, the adoption of "foreign" dietary practices and a distinct identity by Romanized upper-class Egyptians is reflected in the preference for elite cuisine within the farthest reaches of the centre and cultural heart of the Roman Empire, whereas resistance to the adoption of such external dietary customs is observed in Second Temple period Judea among both established urbanites and desert-dwelling cults.

We hope that this volume will provide a useful resource for researchers interested in the human past, both within and outside of the field of zooarchaeology, by offering an illustration of the broad range of questions and contexts in which questions of identity can be tackled effectively using zooarchaeological tools in a down-to-earth manner. We would like to take this opportunity to thank the contributors to this volume for entrusting us with the publication of their research; to the Israel Science

Foundation (Grant 52/10 to GBO) for the financial support of the Bones and Identity conference in Haifa in 2013, and to the Faculty of Humanities and Zinman Institute of Archaeology at the University of Haifa for partial funding of this publication.

Chapter 1

Paleolithic Animal Remains in the Mount Carmel Caves: A Review of the Historical and Modern Research

Reuven Yeshurun

This paper summarizes past and contemporary archaeofaunal research in the newly-inscribed World Heritage Site of Nahal Me'arot (the Mount Carmel Caves) in Israel. The site, containing the caves of Tabun, Jamal, el-Wad and Skhul, exhibits a long Lower Paleolithic to Epipaleolithic sequence, important Mousterian human fossils, and the first Natufian basecamp to be explored. Fieldwork in the caves commenced in 1928 and was shortly followed by Dorothea Bate's seminal work on the fauna, setting a baseline for the Levant's Pleistocene faunal succession. Bate's results and interpretations have been discussed and contested or adopted ever since. The history of archaeofaunal research from the 1930s to the present is reviewed and the results are critically evaluated in light of recent research in the Levant. The evolution of archaeofaunal research at Nahal Me'arot neatly summarizes global developments in Paleolithic faunal studies during the last eighty years. Ultimately, a Middle Paleolithic prey-choice pattern and the Natufian economic transition emerge out of these research efforts, as well as evidence for remarkable stability and resilience of Pleistocene paleoenvironments in the Mediterranean Levant.

Only a few case studies provide as nearly a complete overview of the development of archaeofaunal research during the last 80 years, as does the history of animal bone studies in the Mount Carmel Caves. The prehistoric site of Nahal Meʿarot or Wadi el-Mughara (Valley of the Caves) consists of the caves of Tabun, Jamal, el-Wad, and Skhul, all clustered in a cliff overlooking the narrow Mediterranean coastal plain in northern Israel (Fig. 1.1). The caves display a long cultural sequence lasting >500,000 years, from the Lower Paleolithic to the late Epipaleolithic (Weinstein-Evron 2014). The site has been well-known ever since the excavation campaign by British archaeologist Dorothy Garrod from 1929 to 1934, which culminated in two classic publications (Garrod and Bate 1937; McCown and Keith 1939). During that campaign, important Mousterian human fossils were unearthed in the Tabun and Skhul caves, and the first Natufian basecamp to be explored was excavated at el-Wad. The long cultural sequence and important finds, serving as they have as a baseline for Near Eastern prehistory for many years, were main factors in its inscription in the World Heritage list by the United Nations Educational,

Scientific and Cultural Organization (UNESCO) in 2012.

Animal bone studies were incorporated into the project from the beginning of field research. The final publication of Garrod's excavations included Dorothea Bate's seminal report on the faunal remains (Bate 1937), setting a baseline for the Pleistocene faunal succession of the Levant. Bate's results and interpretations have been discussed and contested or adopted in numerous studies ever since (*e.g.* Bar-Oz 2004; Bar-Oz *et al*. 2013; Davis 1982; Dayan 1994a; Garrard 1982; Henry 1975; Higgs 1967; Saxon 1974; Speth and Tchernov 2007; Tchernov 1968; Weinstein-Evron 1994; Yeshurun 2013; Zeuner 1963). The history of the Nahal Meʿarot archaeofaunal research from the 1930s to the present is reviewed here and the results are critically evaluated in light of current research on the site and the region. Following the presentation of the various paleontological and zooarchaeological studies and their evaluation, the Nahal Meʿarot archaeofaunal research is seen as reflecting the development of zooarchaeology, from a paleontological scholarship concerned with grossly reconstructing regional paleoenvironments to a localized, taphonomic-based discipline aimed at deciphering human ecology and behavior and reconstructing social perspectives.

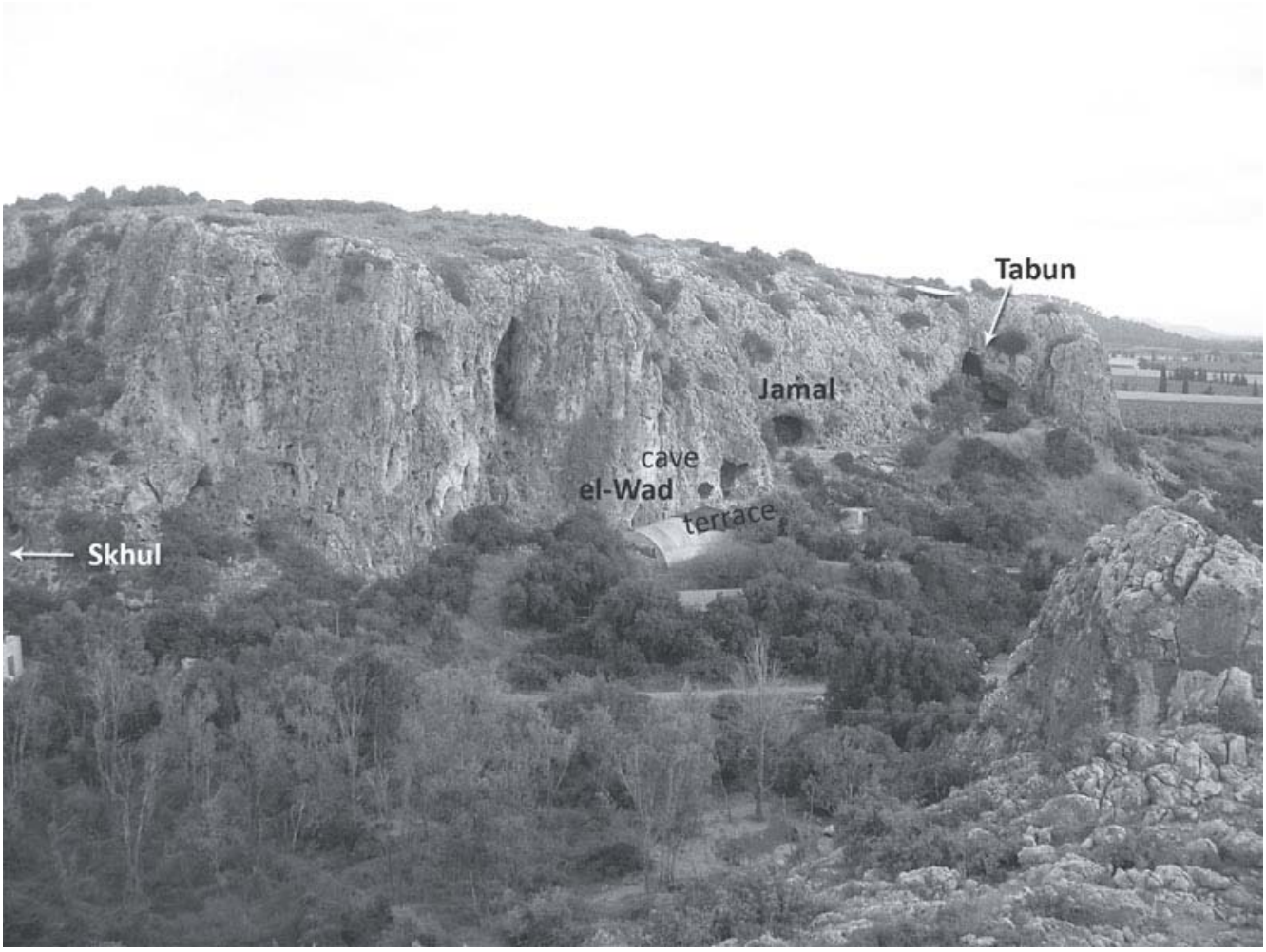

Fig. 1.1. The Nahal Me'arot cliff facing south; the caves of el-Wad, Jamal, and Tabun are visible. Photograph by Reuven Kapul.

Archaeological research in the Mount Carmel Caves

Mount Carmel is an elevated, triangular-shaped area of mostly Cenomanian rock, extending over an

area of 232 km^2 in northern Israel, very close to the Mediterranean coast (Fig. 1.2). The highest summit is 546 m above modern sea level (ASL), but the lower (western) parts of the mountain are only 100–200 m ASL. The proximity to the sea means that the mountain enjoys 600–800 mm of annual rainfall, producing a relatively lush vegetation cover of Mediterranean maquis (Naveh 1984). The Nahal Meʿarot caves are situated on the western face of Mount Carmel, where the cliff of the mountain meets the open expanses of the Mediterranean coastal plain, 45–60 m above modern sea level and 4 km east of the coastline, within the Mediterranean climatic zone of the Levant (Fig. 1.2).

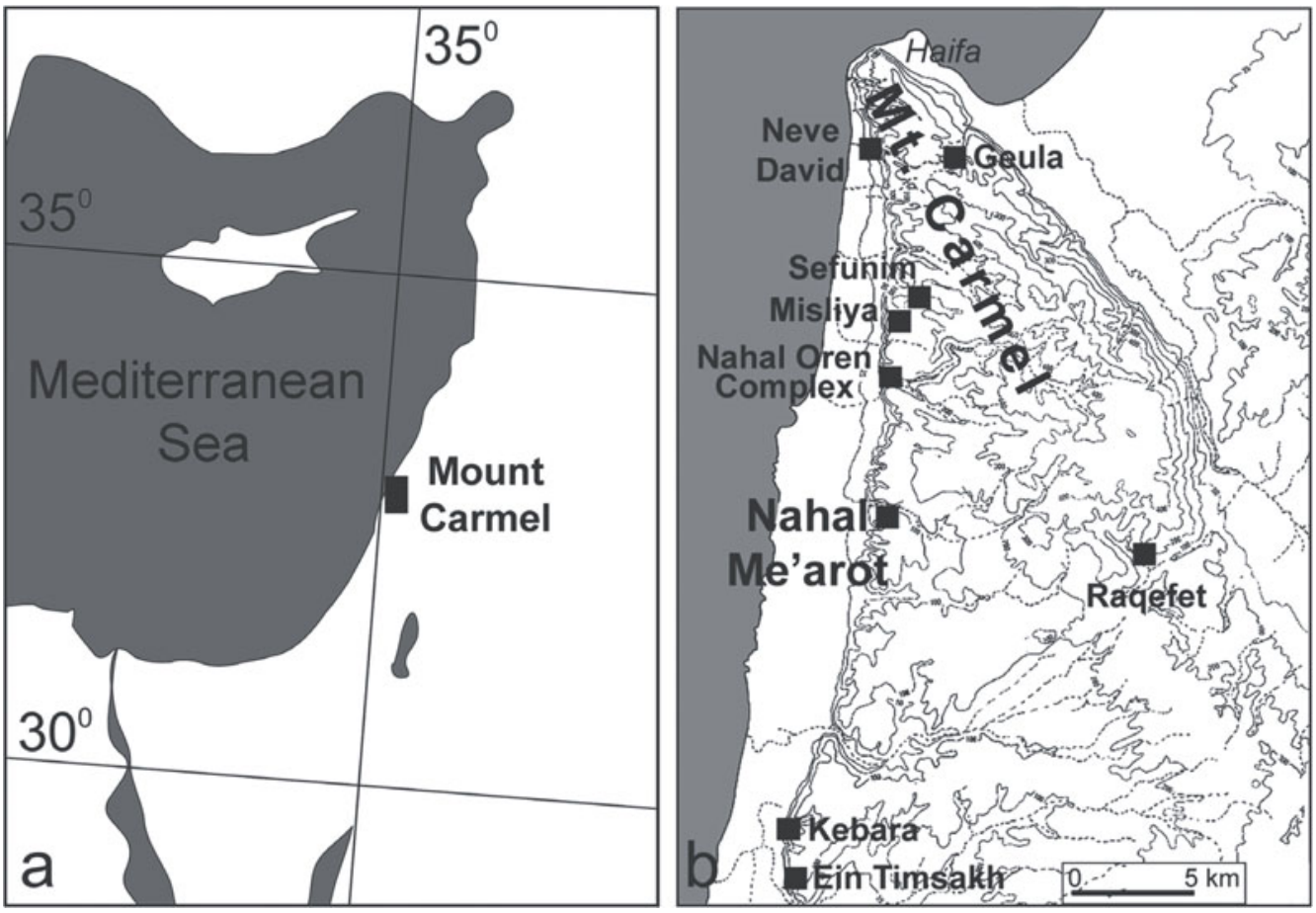

Fig. 1.2. Location map of the Nahal Me'arot caves (Tabun, Jamal, el-Wad, and Skhul) and other Mount Carmel sites mentioned in the text.

The first investigation took place in 1928, when Charles Lambert was sent to investigate the caves on behalf of the Palestine Department of Antiquities, in preparation for the then-planned quarrying away of the cliff. Lambert's finds of the still as yet undefined Natufian Culture of el-Wad led to the recognition of the site's importance (Weinstein-Evron 2009) and Dorothy Garrod was subsequently dispatched to begin a systematic investigation of the Mount Carmel Caves. Her campaign, together with Theodore McCown, was conducted over five seasons from 1929 to 1933 and was summarized shortly thereafter in the two volumes which gained much renown for the caves (Garrod and Bate 1937; McCown and Keith 1939). At el-Wad, Garrod incorporated Lambert's trenches into her extensive excavations of nearly the entire central terrace, Chambers I and II, and much of the cave's dark Chamber III. She discerned Middle Paleolithic (Mousterian) and Upper Paleolithic (Aurignacian and Atlitian) strata, overlain by thick Natufian deposits. The latter turned out to be a rich Natufian

basecamp, the first to be explored, encompassing stone-built walls and pavements, cemeteries, art objects, and abundant cultural material. The definition and interpretation of the Natufian Culture, which essentially remains in force to the present-day, was largely based on these finds (Garrod 1957).

Fifty meters southwest of el-Wad, Garrod excavated the two front chambers of the Tabun Cave, which turned out to be a massive, 25 m thick accumulation of Lower Paleolithic (Upper Acheulian and what would eventually be called Acheulo-Yabrudian) and Middle Paleolithic (Mousterian) layers. The time span represented by the Tabun deposits is conservatively estimated as >500,000 years (Ronen *et al*. 2011). Two types of human fossils were found in Tabun's Layer C, a mandible of debated taxonomic affinity, perhaps an early *Homo sapiens* (Moskovitz and Smith 2005), and a Neanderthal burial. The latter may have been an intrusion from Layer B (Bar-Yosef and Callander 1999). About 150 m northeast of Tabun, the Skhul Cave was excavated during the same years, by Theodore McCown, exposing brecciated Middle Paleolithic deposits containing human remains, currently dated to *ca*. 135–100 ka (Grün *et al*. 2005). These remains were later identified as early anatomically-modern humans, interred with lumps of ochre, marine shell beads, and a grave offering – a boar mandible placed on the chest of one individual. The Skhul and Tabun hominin fossils have figured prominently in subsequent reconstructions of human evolution and dispersal (*e.g*. Bar-Yosef and Vandermeersch 1993; Kaufman 2001; Klein 2009). The combined cultural span of the Tabun and el-Wad Caves offered the most complete prehistoric sequence of the Near East, from the Lower Paleolithic through the Middle Paleolithic, the Upper Paleolithic, and the Late Epipaleolithic Natufian Culture (Table 1.1).

The next campaign at the site took place during five seasons from 1967 to 1971. Arthur Jelinek excavated the upper (Middle Paleolithic) part of the Tabun profile, for the first time employing systematic recovery methods and applying new techniques in sedimentology and palynology (Jelinek 1982; Jelinek *et al*. 1973). Subsequently, Avraham Ronen excavated the lower (Lower Paleolithic) part of Garrod's profile from 1975 to 2003 (Ronen *et al*. 2011; Ronen and Tsatskin 1995). Jamal Cave, located between Tabun and el-Wad, was excavated by Mina Weinstein-Evron from 1992 to 1994 yielding an Acheulo-Yabrudian industry (Weinstein-Evron and Tsatskin 1994; Zaidner *et al*. 2005). At el-Wad, the Natufian stratigraphy was refined from 1980 to 1981, when limited excavations were conducted by François Valla and Ofer Bar-Yosef on the terrace (Valla *et al*. 1986). From 1988 to 1989, Mina Weinstein-Evron (1998) carried out limited excavations in Chamber III of the el-Wad Cave. Weinstein-Evron, Daniel Kaufman, and the author have been excavating the Natufian deposits in the northeast terrace of el-Wad since 1994 (Weinstein-Evron *et al*. 2007, 2012a, 2013). Importantly, all of these projects, starting with Jelinek's, emphasized systematic retrieval of faunal (and other) remains by sieving. However, in the renewed projects significant faunal assemblages have only been discovered in the Natufian deposits of el-Wad, with the exception of a microvertebrate collection from Jelinek's Tabun excavation.

Table 1.1. Garrod's cultural sequence at Nahal Me'arot (Garrod and Bate 1937).

Site & Layer	*Period*	*Culture*	*Age*
Tabun G	Lower Palaeolithic	'Tayacian'	Undated
Tabun F	Lower Palaeolithic	Acheulian	Undated; prob. >400 ka
Tabun E	Lower Palaeolithic	Acheulo-Yabrudian	324±21 – 264±28 ka
Jamal	Lower Palaeolithic	Acheulo-Yabrudian	>220 ka
Tabun D	Middle Palaeolithic	Mousterian	256±26–196±21 ka
Tabun C	Middle Palaeolithic	Mousterian	165±16 ka
Skhul B	Middle Palaeolithic	Mousterian	135–100 ka
Tabun B	Middle Palaeolithic	Mousterian	Undated; prob. 75–47 ka
el-Wad E-D	Upper Palaeolithic	Aurignacian	Undated; prob. 35–30 ka
el-Wad C	Upper Palaeolithic	Atlitian	Undated; prob. 26–23 ka
el-Wad B	Epipalaeolithic	Natufian	Early: 15,000–13,700/13,000 cal BP Late: 13,700/13,000–11,700 cal BP

Note: The modern chronological framework given above is based on Mercier and Valladas (2003), Grün *et al*. (2005), and Weinstein-Evron *et al*. (2001, 2012a). For undated strata the age is based upon culturally similar deposits at other sites in the Levant (Bar-Yosef and Garfinkel 2007). Note that Tabun B has been dated by several methods which have not yielded consistent results (see Hovers 2009: 268).

Extensive fieldwork has been conducted in nearby caves in Mount Carmel. The mountain displays a rich prehistoric sequence in *ca*. 200 caves, rock-shelters, and open-air sites, spanning hundreds of thousands of years from the Middle Pleistocene (Olami 1984). Notable systematic excavations outside Nahal Me'arot include the Kebara Cave (Bar-Yosef and Vandermeersch 2007), the Raqefet Cave (Nadel *et al*. 2012), and the Sefunim Cave (Ronen 1984), all of which have been excavated by several expeditions revealing late Middle Paleolithic to Epipaleolithic layers; the Misliya Cave, where an Acheulo-Yabrudian to Early Mousterian sequence was found (Weinstein-Evron *et al*. 2012b); the Middle Paleolithic cave of Geula (Wreschner 1967); the Epipaleolithic-Early Neolithic site of Nahal Oren (Stekelis and Yizraeli 1963); and the Epipaleolithic site of Neve David (Kaufman 1989).

Animal remains in the Mount Carmel Caves

The beginning: taxonomy and paleoenvironments

> "The most important information which the prehistorian may hope to glean from a cave fauna seems to be whether or not it provides any evidence of differences from the animal population now living in the same area." (Bate 1932: 277).

The first to study the Nahal Me'arot faunas was the British paleontologist Dorothea Bate, who produced a seminal faunal report (Bate 1937). The collaboration between the excavators (Garrod and her team) and the faunal analyst was exceptional. In addition to the mutual research interests, Bate and

Garrod were close friends and Bate spent some time in the field during the excavations, getting a first-hand impression of the context of the finds (Shindler 2005). In spite of this fact, Bate's research goals had nothing to do with the archaeology of the caves; her aim, in line with the accepted practice of her time, was the reconstruction of the natural history of the Pleistocene fauna of the Levant region. Although she was fully aware of the association of the fossils with numerous human occupations (*e.g.* Bate 1937: 140), she did not deal with the human impact on the assemblages or attempt to raise economic and behavioral questions, with the important exception of dog domestication (see below). Nevertheless, her study of the fauna of the Carmel Caves was pioneering in many respects. She described several new species, and identified several others which had not previously been known to have existed in this country in the Pleistocene; she constructed one of the first quantitative curves of faunal succession and discussed its bearing on the ancient climate; she identified a faunal break between primitive and modern-like mammal communities during the Middle Paleolithic; and she recognized for the first time a domestic animal in the Pleistocene.

The two most abundant species in the Nahal Meʿarot sequence, showing marked fluctuations in their relative frequency through time, were the Mesopotamian fallow deer (*Dama mesopotamica*) and the mountain gazelle (*Gazela gazella*; initially defined as *Gazella* spp. by Bate). Bate attributed shifts from deer to gazelle dominance as reflecting changing regional vegetation and paleoclimates. An abundance of woodland-dwelling deer, relative to gazelle, was taken by Bate to indicate a humid phase and contracting "open" biomes, while the increase in steppe-adapted gazelles relative to deer signaled desiccation and the contraction of woodlands. According to this scheme, the deer-dominated Tabun F, E, and especially layer B were interpreted as humid periods while Tabun C and especially el-Wad B (the Natufian), where deer is almost entirely absent relative to gazelle, were interpreted as dry periods (Fig. 1.3). The famous *Dama-Gazella* graph is probably Bate's most important conceptual contribution to the study of archaeofaunas in the Levant and beyond, despite the fact that her actual conclusions have been widely contested (see below).

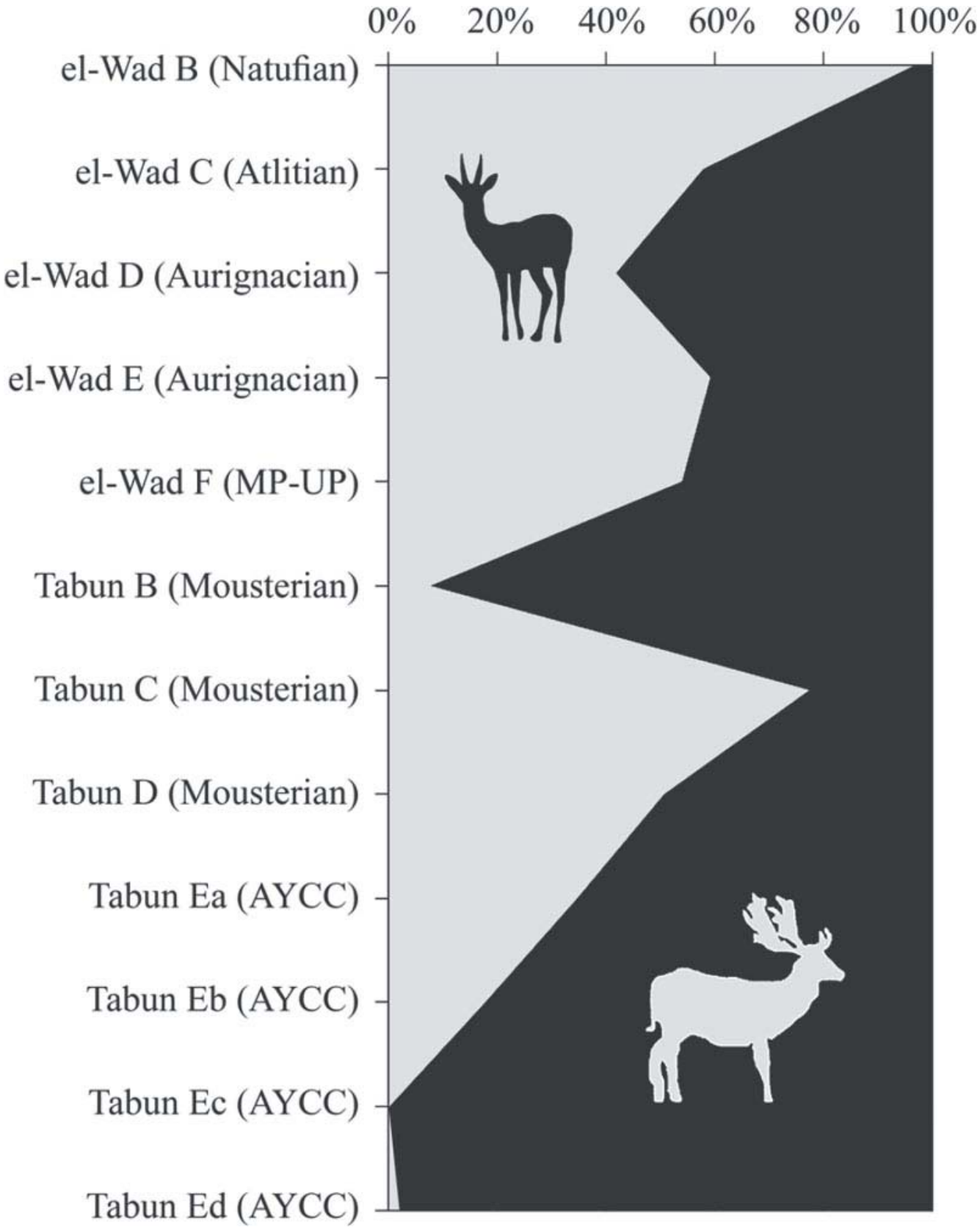

Fig. 1.3. Bate's Dama-Gazella *chart, redrawn after Bate (1937). Note: AYCC, Acheulo-Yabrudian Cultural Complex; MP-UP, Middle Paleolithic–Upper Paleolithic layer.*

In addition to recognizing, for the first time, several animals that had been locally extinct in the country and previously unknown in the Levantine fossil record (such as the spotted hyena, *Crocuta*

crocuta, the hartebeest *Alcelapus* sp., the horse *Equus caballus*, the elephant *Elephas* sp., the freshwater turtle *Trionyx* sp., and the crocodile *Crocodilus* sp.), Bate (1937) described 12 new and globally-extinct mammal species, mostly from the older Middle Paleolithic sequence of Tabun (layer C and below) and Skhul. Among them were the hedgehogs *Erinaceus sharonis* and *E. carmelitus*, the voles *Ellobius pedorychus*, *Microtus mccowni*, and *M. machintoni*, the fox *Vulpes vinetorum*, the warthog (named in honor of the project director) *Phacochoerus garrodae*, and the large boar *Sus gadarensis* (see also Bate 1942, 1943). Subsequently, a camel (*Camelus* sp.) bone was identified in the Tabun C collection (Payne and Garrard 1983). Bate used the apparent replacement of these "primitive" forms by modern-day species in the transition from Tabun C and Skhul to Tabun B to argue for a Great Faunal Break (GFB) which took place during the Middle Paleolithic. The paleoenvironmental significance of this break was seen as increased rainfall and some cooling; Bate interpreted the Tabun C period as dry climate but with nearby perennial streams, and Tabun B as cold and humid. With subsequent discoveries of additional dated fossil material, larger available comparative collections from the Levant, and the advance of quantitative and statistical methods, later researchers either revised or entirely cast doubt on the validity of many of these taxa, and consequently on the existence of the GFB (*e.g*. Haas 1959; Heller 1970; Hooijer 1959; Kurtén 1965; Tchernov 1988). A few of the GFB elements are still accepted today, especially the change in rodent faunas during the Middle Paleolithic which was used to correctly place chronologically the Skhul/Qafzeh faunas (now known to be of Marine Isotope Stage [MIS] 5 age) before those of Tabun B/Kebara, which date to the MIS 4 and MIS 3 respectively (Tchernov 1981).

Bate briefly described the first case of Pleistocene animal domestication based on a putative dog (*Canis familiaris*) skull in the Natufian of el-Wad. Her qualitative description (Bate 1937: 176–177) essentially used the principal osteological criteria for discerning dogs from wolves in the present time: shorter muzzle, smaller teeth, and lower braincase. Decades later, more remains of Natufian dogs came to light, some originating from interments at 'Eynan and the Hayonim Terrace (both in northern Israel), whose osteological characteristics reinforced Bate's identification (Davis and Valla 1978; Dayan 1994b; Tchernov and Valla 1997). Numerous human burials, some displaying animal parts and other associated artifacts, were discovered at el-Wad, and it is now evident that many of the graves were missed or inadequately documented during the 1930s excavation (Weinstein-Evron 2009). Remains of large canids were found in the new excavations at el-Wad, but these were lacking a funerary association and were all in a fragmentary condition (Rabinovich 1998; Yeshurun 2011). Given the exceptional completeness of the described dog skull (see Bate 1937: fig. 4a, b), it is tempting to speculate that it, too, belonged to an interment that went unrecognized due to Garrod's crude excavation methods.

Taphonomy and human subsistence patterns

> "While a cultural filter tends to distort paleoenvironmental reconstructions, biased faunal remains can reveal a great deal about prehistoric behavioral patterns." (Henry 1975: 383).

The development of the archaeological discipline of zooarchaeology and its "sister" discipline of archaeological taphonomy, well after Bate's time, shifted the focus of archaeofaunal studies to human subsistence and behavior (see Gifford 1981; Reitz and Wing 2008: ch. 2). The large faunal assemblage from Bate's original study was restudied twice, in the 1980s by Garrard (1980, 1982) and recently by

Marín-Arroyo (2013a, b). Both studies emphasized the importance of the collection for inferring human subsistence patterns, either as an additional line of inquiry supplementing and constraining Bate's paleoenvironmental interpretation in the case of Garrard's work, or as a research goal in itself, as deemed by Marín-Arroyo. Garrard (1980) aimed to present specimen counts for all ungulates and construct their mortality profiles and body-part distribution, in order to discern which animals constituted the bulk of those hunted during each period, which herd individuals were chosen, and which body parts were transported back to the cave and why. During the 1970s–1980s, similar studies were conducted in other caves on Mount Carmel (Davis 1977; Noy *et al*. 1973; Saxon 1974), in line with the development of explicitly-zooarchaeological or "paleoeconomic" studies worldwide (Klein and Cruz-Uribe 1984).

Marín-Arroyo's study made use of state-of-the art taphonomic techniques, such as detailed documentation of bone surface modifications. This enabled, for the first time, establishing the depositional origin of the assemblages. It was found that most of the material is indeed anthropogenic, displaying cutmarks, hammerstone-percussion marks, and bone-burning. Importantly, the Middle Paleolithic layers of Tabun are remarkably different in their taphonomy, not just the relative taxonomic proportion (the Lower Paleolithic specimens were not included in the renewed study): the proportions of butchered, burned, and gnawed bones in Tabun B are much reduced compared to those from Tabun C, leading to the interpretation of the latter as a relatively intensive human occupation while Tabun B was only sporadically-used by humans (Marín-Arroyo 2013a, b). Ungulate mortality profiles in the anthropogenic layers indicated active and regular hunting by Middle Paleolithic hominins because mature animals, mostly of prime-age, were present, similar to other contemporaneous sites in the region (Marín-Arroyo 2013a; compare Speth and Tchernov 1998; Stiner 2005; Yeshurun *et al*. 2007).

On the other hand, the new study served to highlight the significant collection and curation biases of Garrod's material. Nearly all of it is composed of dental remains, complete bones, or long-bone ends attributable to species, while almost no long bone shaft fragments or other elements deemed "non-diagnostic" were retained (Marín-Arroyo 2013a). Additionally, the unsystematic collection was not uniform among caves or strata. The Skhul Cave material, coming from hard breccia matrix (McCown 1937), was dominated by isolated teeth of aurochs (*Bos primigenius*). Brecciated deposits are well-known in Mount Carmel and extracting bones from them is notoriously difficult and very time-consuming. In the "Tabun-D type" layers of Misliya Cave it has been observed that such deposits are biased in favor of large or very durable elements and larger animals relative to the softer sediments of the same site (*e.g*. Bar-Oz *et al*. 2005; Weinstein-Evron *et al*. 2012b). Similarly, the contemporaneous rock-shelter of 'Ein Timsakh, in the southwestern corner of Mount Carmel, also exhibits brecciated deposits yielding only medium- and large-sized ungulates (Yeshurun and Bar-Oz 2008). Thus, it is difficult to ascertain whether the economy of the Early Modern Humans at Skhul was indeed characterized by specialized aurochs hunting, or rather the picture obtained is a biased one attributable to the nature of the sediment, or to Garrod's collection and retention procedures (Marín-Arroyo 2013a).

Archaeofaunal studies of material from modern excavations have mostly focused on the Natufian deposits of el-Wad, where numerous faunal remains were discovered in all soundings. The 1980s soundings conducted on the terrace produced the first systematically-collected microvertebrate sample at the site. It indicated a mosaic of open and wooded Mediterranean environments in the vicinity of the

Natufian hamlet, similar to the present-day. Some remains of Mediterranean fish were also found (Valla *et al*. 1986). However, it became clear that demonstrating the role of small animals in the Natufian economy as well as the reliability of small vertebrates for paleoenvironemental reconstruction must make use of taphonomic and actualistic techniques to reveal the collecting and modifying agents of the bones. The Chamber III excavation produced a rich macrofaunal assemblage, taphonomically demonstrated to be anthropogenic, and dominated by mountain gazelle, Mesopotamian fallow deer, Cape hare (*Lepus capensis*), and other types of small game (Munro 2004; Rabinovich 1998).

The renewed el-Wad Terrace excavations have produced Early Natufian and Late Natufian faunal assemblages, the former associated with significant architectural remains. Gazelle and small game species were primarily exploited throughout the sequence (Yeshurun *et al*. 2014a). In order to determine the economic change in the sedentary Natufian hamlet *vs*. the relatively mobile pre-Natufian camps, Bar-Oz (2004) compared the el-Wad fauna to the closest assemblages in time and space. He used the Epipaleolithic (Kebaran and Geometric Kebaran) sequence of Israel's coastal plain, under the premise that such control of the ecological region and tight chronological boundary are vital for understanding the Natufian in light of its immediate predecessors. These predecessors, who enjoyed a similar array of natural resources in the same region as the Natufians of el-Wad, focused on hunting gazelle, fallow deer, and larger ungulates, with a low proportion of small game species, in contrast with the Natufian economy (Fig. 1.4; Bar-Oz and Dayan 2002, 2003; Bar-Oz *et al*. 1999; Stutz *et al*. 2009). Despite the overwhelming dominance of gazelle over any other ungulate in the Natufian, no evidence was found for their specialized culling (selection for a particular age or any form of cultural control), contrary to previous claims (Bar-Oz *et al*. 2004).

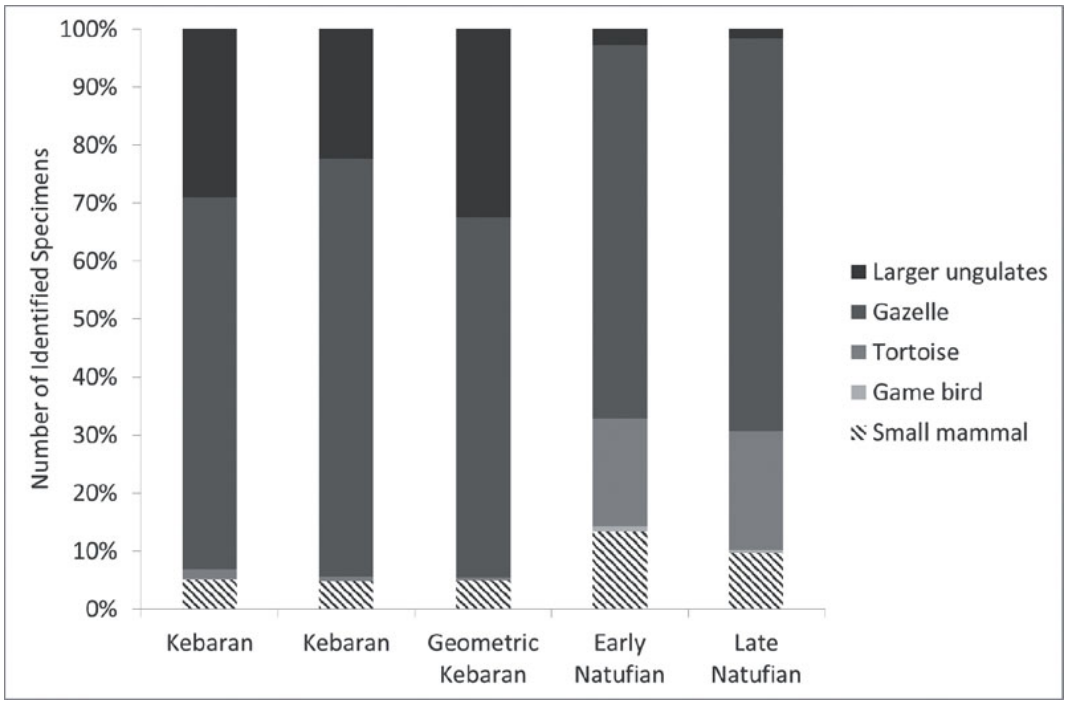

Fig. 1.4. The Natufian economic transition: a comparison of the el-Wad faunal composition with pre-Natufian assemblages of the same region. Data are from Bar-Oz (2004) and Yeshurun et al. *(2014a).*

Micromammal remains are ubiquitous at Natufian el-Wad, and have been systematically retrieved in the modern excavations. Detailed taphonomic analyses have shown that they originate mostly from

predation by owls, whose pellets fell from the overlooking cliff, underwent dispersal, and became deposited the archaeological layers (Fig. 1.5). Therefore, most micromammal remains represent the setting of the site during the time of deposition (Weissbrod *et al*. 2005). The taxonomic composition of these samples is similar to the composition of recent owl pellet assemblages from Mount Carmel and represents a similar mosaic of mesic and xeric Mediterranean habitats like those found there today. In addition to the owl predator source of most of these micromammal remains, others (the murids and *Acomys*) may be related to commensal activities (Weissbrod *et al*. 2005, 2013). Even more so, the context, taphonomy, and demography of mole-rats (*Spalax ehrenbergi*) from Natufian el-Wad strongly suggest their consumption by humans (Weissbrod *et al*. 2012).

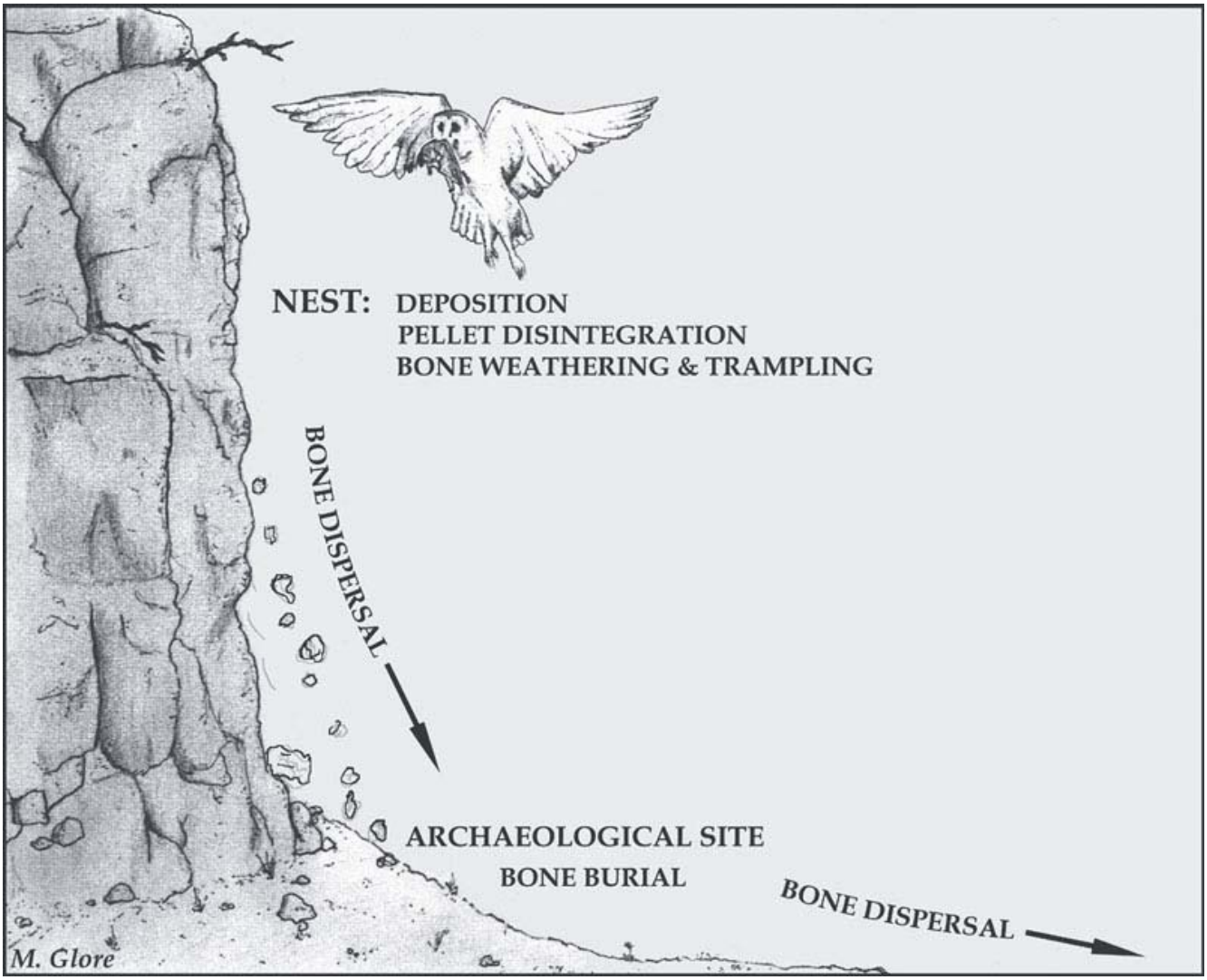

Fig. 1.5. A schematic model showing the deposition and dispersal of micromammal remains at the Natufian el-Wad Terrace, after Weissbrod et al. *(2005, fig. 15).*

The exploitation of marine faunal resources is also evident at el-Wad, currently the Natufian site closest to the Mediterranean shore. Fish remains suggest exploitation of the Mediterranean littoral and estuarine zones (Bar-Yosef Mayer and Zohar 2010). Large and particularly rich assemblages of marine shells were retrieved during all excavation campaigns at el-Wad. Numerous Scaphopods and a rich variety of bivalve and gastropod taxa were used as beads and pendants (Bar-Yosef-Mayer 2005; Garrod and Bate 1937) and some edible mollusks, such as the Mediterranean limpet *Patella caerulea*,

were also found (Weinstein-Evron *et al*. 2007).

Towards "Social Zooarchaeology" and "Contextual Taphonomy"

> "Animal bone has major but largely untapped potential to contribute to contextual interpretation because it is relatively durable, yet soft enough to record many of the processes that shape not only faunal assemblages but also site formation." (Russell 2014: 611).

Contemporary research on the archaeofauna of the caves has revealed some interesting new angles. Building upon increasingly rigorous excavation and bone collection methods, as well as new analytical and theoretical advances, zooarchaeologists have begun to extract information pertaining to intra-site patterns, ultimately producing reconstructions of Paleolithic societal patterns. The first example from Mount Carmel is from the Kebara Cave, where multivariate comparisons of bone sub-assemblages were performed to track refuse maintenance patterns and site organization in the late Middle Paleolithic. Detailed taphonomic comparisons of a large midden near the cave wall and the area of the hearths at the center of the cave demonstrated that consumed ungulate remains were habitually tossed toward the cave wall, producing a unique pattern of Neanderthal "housekeeping" (Speth 2006; Speth and Tchernov 2007).

Yeshurun (2011; Yeshurun *et al*. 2013a, 2013b, 2014b) recently applied a contextual taphonomy approach to Natufian animal remains in order to discern the formation and function of architectural contexts in this early sedentary society. Contextual taphonomy involves the integration of the stratigraphic and contextual data with zooarchaeological and taphonomic data, to elucidate the "life history" of a faunal assemblage in a given context; animal remains are potentially excellent indicators of site-formation processes, refuse behavior, and the location of activity areas (Yeshurun *et al*. 2014b). At the Early Natufian basecamp of the el-Wad Terrace, contextual taphonomy showed that a sequence of structures was used for everyday activities, including food preparation and consumption – probably at the household level – as well as the working of bone (Fig. 1.6). Despite the relatively permanent habitation, reflected by the repeatedly renovated stone architecture of the basecamp, a broad-spectrum economy, and the heavy damage inflicted on *in situ* refuse, the inhabitants did not systematically engage in clearing away of organic trash or otherwise delineating their dwellings, a fact which sheds important light on the human perception of the house during this period (Yeshurun *et al*. 2014b). A comparison of the animal remains found at the Late Natufian cemetery in the Raqefet Cave with the el-Wad habitations showed the former to reflect short and punctuated periods of human activity, reaffirming its interpretation as a specialized burial site (Yeshurun *et al*. 2013b).

Needless to say, the contextual taphonomy approach may also prove essential for general paleoeconomic and paleoenvironmental reconstructions. Taxonomic frequencies may be heavily influenced by architectural context and differential intra-site states of preservation (Weissbrod *et al*. 2013). In addition, the ancient function of excavated localities may affect paleoeconomic inferences. Feasting activities or ephemeral use of parts of large and complex sites may introduce serious biases when evaluating the long-term subsistence trends of Epipaleolithic households (Munro and Grosman 2010; Yeshurun *et al*. 2013b, 2014a). This type of study requires good control of the archaeological contexts of the bones, full collection and analysis procedures, and laborious recording of taphonomic variables. In return, a more socially-oriented and localized zooarchaeological view can be offered (Russell 2012) for the life of the Paleolithic and Epipaleolithic inhabitants of the Mount Carmel Caves.

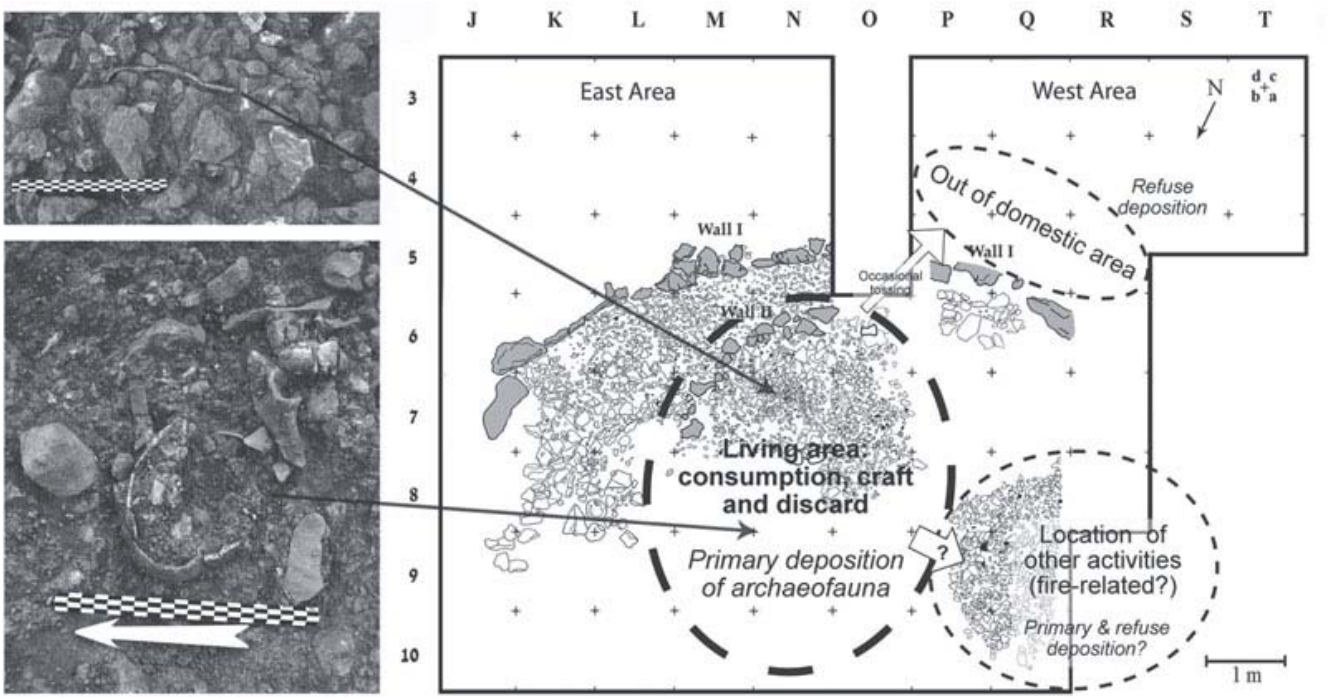

Fig. 1.6. The interpretation of a contextual taphonomy analysis in the Early Natufian hamlet of the el-Wad Terrace, modified after Yeshurun et al. *(2014b). Bone taphonomy shows significant differences among architectural contexts, allowing the interpretation of their formation and use: (A) A gazelle rib trampled into a domestic stony floor and preserved* in situ*; (B) Lithics and tortoise and gazelle skeletal elements in one of the living surfaces outside the stony floor*.

Discussion

The evolution of archaeofaunal studies in Nahal Me'arot

The survey of the different works related to the faunas of the Mount Carmel Caves was presented above in a more-or-less chronological order, inasmuch as each generation of scholarship builds upon previous works, refining and revising them. Thus, subsequent to Bate's pioneering research, her identifications and paleoenvironmental conclusions have been widely debated due to the unsystematic collection and analysis methods which characterized them, the inappropriate tallying methods used, and the lack of taphonomic data elucidating how these bones reached the cave in the first place (Bar-Oz *et al*. 2013 and references therein). Nevertheless, Bate's landmark report still stands as a focal point for archaeofaunal studies in the Pleistocene of the Levant. The new perspectives subsequently added have made use of increasingly refined excavation and quantification procedures, as well as novel analytical approaches.

The importance of the development of field methods for archaeofaunal studies during the twentieth century cannot be over-emphasized. Many of the novel approaches developed from the 1980s on could not have been implemented in excavations such as Garrod's, or would have suffered from serious biases due to her rapid digging and unselective retention. A striking example for the collection's bias is the micromammal tallies on which Bate based some of her interpretations. In el-Wad B she reported just two specimens of *Microtus* (Bate 1937: 152) whereas this genus is extremely abundant in the recent excavations which employed systematic collection (Weissbrod *et al*. 2005). The same bias possibly also prevented Bate from recognizing the immense quantity (and important

economic role) of small animals in the Natufian. While she does mention sporadically that fox (*Vulpes vulpes*), hare (*Lepus capensis*), and mole-rat (*Spalax* sp.) are more numerous in el-Wad B compared to any other layer, Bate does not draw any conclusion from this. Rather, more than 60 years would elapse until tallying the remains of these species, documenting their contexts, and searching for signs of consumption first led other researchers to the conclusion that these faunas constituted a significant part of the Natufian's broad-spectrum subsistence (Bar-Oz 2004; Munro 2004; Weissbrod *et al*. 2012; Yeshurun *et al*. 2014a). Similarly, the contextual taphonomy approach would be impossible to implement had it not been for the careful documentation of bones in their respective stratigraphic and spatial contexts (Yeshurun *et al*. 2014b).

Bate's quantification method also in effect masked the Natufian economic shift and produced an untenable environmental interpretation. Tallying just two species, one against the other, in the famous *Dama*/*Gazella* graph, means that when fallow deer drops gazelles must go up – even when, as happened in the Natufian and probably already the Upper Paleolithic – gazelle frequencies out of the total fauna remained largely unchanged (Davis 1982; Speth and Tchernov 2007). Indeed, subsequent research has convincingly demonstrated that the near-disappearance of deer during the Natufian of el-Wad did not result from extreme desiccation, as argued by Bate, but from economic intensification related to rising populations and sedentism (see the discussion in Bar-Oz 2004; Bar-Oz *et al*. 2013).

In addition to issues related to collection and quantification methods, it is the subsequent inclusion of taphonomy into research approaches which seriously challenges Bate's paleoenvironmental interpretation. To give but one example, Jelinek *et al*. (1973) has suggested that the preponderance of fallow deer in the Tabun B assemblage was not due to increased rainfall (Bate 1937) but to the opening of the karstic chimney, enabling the use of the cave as a natural pitfall, entrapping animals. Garrard (1982) and Marín-Arroyo (2013a), who restudied the remains found at the base of the chimney, argued that their state and context point to a natural pitfall trap which was sporadically used by humans. The function and formation of the Tabun B fauna may be further elucidated by a recently found locality which may serve as an interesting comparison. The 2005 excavation of the Rantis Cave in west-central Israel revealed geomorphological, archaeological, and taphonomic evidence of its having been a natural pitfall trap, used to capture ungulates and carnivores at broadly the same time as Tabun B. The ungulate assemblage collected there is similar to that of Tabun B in its predominance of fallow deer and the rarity of butchery marks and carnivore gnaw marks on the bones (Marder *et al*. 2011). Thus, the difference in the agent of accumulation, rather than true natural availability (and consequently climate), was probably responsible for the lower proportions of *Dama* from Tabun C and D. In light of the data from the Rantis Cave, Yeshurun (2013) argued that discerning Middle Paleolithic prey-choice can utilize contemporaneous non-anthropogenic assemblages as a natural reference. Thus, Tabun B could prove extremely useful in the ongoing quest to separate natural availability of game from human hunting preferences.

In spite of the critical evaluation of Bate's conclusions, many of which become untenable when approached with modern standards of excavation, analysis, and frames of reference, her contribution to the study of Pleistocene fauna of the Levant is indispensable. Her publications dealing with the faunas of the Mount Carmel Caves have inspired generations of paleontologists and zooarchaeologists, have pointed out several phenomena which still need to be explained, and have raised many of the important research questions we are still dealing with today.

What have we learned from all this?

The study of animal remains from Paleolithic sites is performed to better understand the past, whether it be the "bigger picture" of human evolution and paleoenvironments, or more localized subsistence, behavior, and social patterns. Following this brief and critical review of archaeofaunal research for the Mount Carmel Caves, what conclusions can be drawn at this stage in time regarding the ancient inhabitants of the caves and their natural surroundings? Here I focus on two issues: the evolution of human hunting, including stricter prey selection and the Broad Spectrum Revolution; and the environmental resilience of the Eastern Mediterranean Levant.

Active and regular ungulate hunting is well-documented as early as the late Lower Paleolithic for the Qesem Cave in central Israel, this being the only parallel to the Tabun E fauna (Blasco *et al*. 2014; Stiner *et al*. 2011). However, the question of prey-choice *vs*. natural availability is still vague. In Tabun E, fallow deer was abundant, alongside gazelle and nine other ungulate species (Bate 1937), whereas in Qesem fallow deer dominates but gazelle (and other Afro-Arabian mammals) are virtually absent. This trend has been interpreted as being climate-driven; the preponderance of gazelle in the succeeding early Middle Paleolithic of the Levant was seen as signaling a drying trend in a time, comparable to the Tabun E–D transition (Stiner *et al*. 2011). However, gazelle are present throughout most of the thick Tabun E sequence, as is a single specimen of elephant (*Elephas* sp.) and hartebeest (*Alcelaphus* sp.) (Bate 1937). The environment could not have been very much different at Tabun than it was at Qesem, and it therefore may be suggested that actual hunting choice in favor of deer (or against gazelles) was prevalent in the Amudian of Qesem Cave, for whatever reason (*e.g*. Blasco *et al*. 2014). More faunal material from Acheulo-Yabrudian sites and a more refined chronology of the Tabun E sediments are needed to examine these two hypotheses (climate *vs*. choice) which may not be mutually exclusive.

This issue becomes clearer in the Middle Paleolithic, where several well-published faunas are known from different ecological regions and depositional scenarios (Speth 2012). In the Mediterranean Zone of the Levant, anthropogenic cave faunas appear to be biased in favor of gazelles when compared with natural accumulations, which are always richer in larger ungulates (Yeshurun 2013). This trend is most apparent in the relatively intense occupations of Tabun C, in contrast with the Tabun B layer, which seems to have been created mostly by non-anthropogenic processes (Marín-Arroyo 2013a). The hyena-accumulated fauna of Geula Cave also displays more deer (and larger ungulates) relative to gazelle (Monchot 2005). The newly recognized "natural reference" sites may be biased in favor of deer for reasons other than natural availability, namely the presence of water which attracts more obligate drinkers such as deer (Speth 2012). However, the consistency of this pattern at three different non-anthropogenic assemblages (Rantis, Tabun B and Geula) seems to rule out localized patterns of selective deposition. Thus, hunting strategies in the Levantine Mousterian, while still conservative by later standards (Stiner 2013), may already reflect socially- or technologically-driven preferences for a specific prey (gazelle), as opposed to simply taking whatever is naturally available in the vicinity of the sites. Garrod's Middle Paleolithic faunal sequence for Tabun, excavated in thick units, is not sufficiently refined to pinpoint shorter-term patterns of hunting evolution, as has been accomplished with the detailed late Middle Paleolithic sequence of the Kebara Cave (Speth 2013; Speth and Clark 2006).

The long Nahal Meʿarot sequence reflects another major change in subsistence patterns: the broadening of the spectrum of hunted animals to include a variety of small game species, from lizards

and birds to hares and tortoises, probably as a result of rising human population (Stiner *et al*. 1999, 2000). This trend is to some degree already apparent in the Middle and Upper Paleolithic of the Levant (Stiner 2001), but reaches unprecedented levels in the terminal Pleistocene Natufian, when animal diet was based on gazelles, hares, tortoises, foxes, mole-rats, partridges, lizards, and the like, both at el-Wad (Bar-Oz 2004; Munro 2004; Rabinovich 1998; Weissbrod *et al*. 2012; Yeshurun *et al*. 2009, 2014a) and elsewhere (Munro 2004, 2009). This intensification trend signifies an economic break from the big-game hunting strategy of the Paleolithic (and the earlier Epipaleolithic), and is interrelated with increasing sedentism and more sophisticated food-acquisition methods such as trapping (Yeshurun *et al*. 2014a and references therein). Somewhat surprisingly, in the relatively sedentary Natufian context, butchered animal remains at el-Wad were still discarded on the spot, with little evidence of domestic cleaning, thus continuing the simple camp maintenance traditions of earlier foragers (Yeshurun *et al*. 2013a, 2014b).

The paleoeconomic assertions delineated above bring us full circle back to Bate's paleoclimatic interpretation of the archaeofaunal sequence. It has been shown that cultural, analytical, or taphonomic explanations of the variability of ungulate frequencies exist in most cases, be it the brecciated Skhul deposits, the taphonomic origin of Tabun B, or the overlooked small-game economy of el-Wad B. The micromammal variability is also the product of several depositional mechanisms, including human intervention. When site-specific taphonomic and analytical biases are taken into account, Bate's views, innovative and inspirational as they were, generally do not hold. Needless to say, these caveats by no means suggest that we should abandon fossil Pleistocene mammals as indicators of human paleoenvironment in the Levant. Hunted and naturally-deposited mammal communities are still one of the best indicators for a site's environment, provided that the taphonomic, anthropogenic, and site-specific biases are explicitly recognized and taken into account. As humans are themselves large mammals, the range and abundance of other mammals potentially reflect environmental conditions on the "human" scale, and furthermore constitute direct proxies for patterns of human resource exploitation.

The emerging picture reveals that large-mammal communities from the immediate vicinity of the Mount Carmel Caves have not undergone significant changes since at least the Middle Pleistocene and that the terminal Pleistocene micromammal community at el-Wad is similar to that of the present-day. This picture might mean that paleoclimatic fluctuations were mild for this region during the period in question and thus should not have significantly affected the human populations. However, this conclusion needs to be carefully scrutinized, as other paleoclimatic proxies are not necessarily in agreement (see the discussion in Weinstein-Evron 1998). Nevertheless, it is important to draw attention to the outstanding mosaic of biomes represented by the fossils (already acknowledged by Bate (1937: 140)) and the remarkable continuity and resilience of Levantine faunas during this long time-frame (Bar-Oz 2004; Belmaker 2008, in press; Belmaker and Hovers 2011; Tchernov 1988, 1998). Rather than seeking "faunal breaks," recognition of faunal continuity is needed in order to fully appreciate the co-evolution of humans and animals in the Pleistocene Levant.

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Chapter 2

A New Look at "on Mice and Men": Should Commensal Species be Used as a Universal Indicator of Early Sedentism?

Miriam Belmaker and Ashley B. Brown

One of the main indicators that have been used for early sedentism has been the relative presence of commensal species, since these species have evolved to be dependent on human habitation and have been used as a marker of human dispersal. This paper reviews the model that the house mouse, black rat and house sparrow evolved from local wild progenitors in the Levant ca. 15,000 cal BP during the early stages of sedentism. By reviewing the current evidence for evolution of the species based on genetics and paleontology, exploring the role of taphonomy in the accumulation of microvertebrates such as rodents and passerines and reevaluating the ecological meaning of commensalisms this paper concludes that the relative abundance of these taxa should not be used as an indicator for the earliest stages if sedentism and that the increase in their abundance in the Natufian of Hayonim should be critically viewed through the lens of taphonomy.

Introduction

One of the challenges of the study of early sedentism has been the ability to identify early signs of sedentism at archaeological sites (Bar-Yosef and Belfer-Cohen 1989; Belfer-Cohen and Bar-Yosef 2000; Berelov 2006; Kelly 1992). One of the main indicators that have been used for early sedentism has been the relative presence of commensal species, since these species have evolved to be dependent on human habitation and thus have been used as a marker of human dispersal (Auffray 1988; Auffray *et al*. 1986, 1988; Riyahi *et al*. 2013; Tchernov 1984b). An increase in the population of a commensal species, the house mouse (*Mus musculus*), was first described by Bar-Yosef and Tchernov (1966) based on the finds from the Natufian period of Hayonim. A similar pattern was described by Hesse (1979) to indicate the beginning of year-round occupation of a Neolithic site, Tepe Ganj Dereh: "The sharp increase in the relative frequency of *M. musculus* at Tepe Ganj Dareh indicates a shift from irregular use (with likely winter abandonment) in the earliest period of occupation to year round human settlement."

Tchernov (1984b, 1991a, 1991b) developed a model of commensal species evolution from their wild progenitor, based on a sympatric model of speciation, *i.e*. new species evolve from a common wild ancestor although both occupy to same geographical region (Dieckmann and Doebeli 1999). Tchernov (1984b, 1991a, 1991b) proposed three mechanisms for the evolution of commensal species: *(1)* An increase in sedentism leads to a constant availability of food and/or shelter for species in comparison to wild areas. An increase in human garbage and an increase in the capability of food storage, result in an increase of food for the commensal species. The increase in shelter is a result of the architecture of building in sedentary sites; *(2)* An increase in sedentism leads to regions that are protected from predators and provide sites for protected nests, birth sites and hiding places in comparison to wild areas. *(3)* An increase in sedentism reduces the inter-specific competition in comparison to wild areas. Therefore populations of wild species that inhabited human sedentary sites would have had a selective advantage over their wild ancestors. Over time, this would have led to two distinct gene pools and the evolution a new species, *i.e*. a commensal species derived from the wild progenitor. It was hypothesized that the relationship between humans and commensal species is positive and correlated with the degree of sedentism of man. Gene flow would decrease between wild and commensal populations in direct relation to the increase in sedentism. Thus, the increasing presence of commensal species with increasing sedentism was viewed as a linear process.

Since the first publication of the model, several critiques have been published (Tangri and Wyncoll 1989; Weissbrod 2013). These critiques focused primarily on the role of taphonomy and ethnography in our understanding of microvertebrate accumulation. Tchernov (1991a) had addressed some of the critiques by looking at barn owl ecology. He estimated that overall, owls are opportunistic and therefore consume microvertebrates in proportions to their abundance in the environment and are therefore excellent proxies for the both small mammals and birds in the immediate vicinity to where their pellets are dropped. Despite these early critiques, these conclusions have been widely accepted by archaeologists since its publication as one of the principle methods to identify sedentism in the Natufian (Belfer-Cohen and Bar-Yosef 2000; Boyd 2006; Edwards 1980; Henry 1985) and beyond (Muñiz *et al*. 1995).

Based on this model, we would have expected a rapid increase in the proportion of commensal species from the Epipaleolithic (no sedentism) to that of the first fully sedentary sites in the Natufian. Commensal species abundance is hypothesized to remain stable following the Natufian.

Thus, to test the validity of the model, we can look at long-term diachronic changes in the abundance of commensal species. However, a diachronic study using the date available from the Levant presents a complex pattern (Fig. 2.1). While there is a sharp increase in the presence of *Mus* ssp. between Epipaleolithic sites to Neolithic sites as predicted by the model, there is a decrease in the proportion of commensal species in the following Late Natufian and PPNB. The proportion of commensal species increases again in the Iron Age but is highly variable after. This pattern, and specifically, the decrease in proportion of commensal species after the Natufian, questions the validity of the hypotheses presented by Bar-Yosef and Tchernov (1966), Hesse (1979), and Tchernov (1984b, 1991a, 1991b).

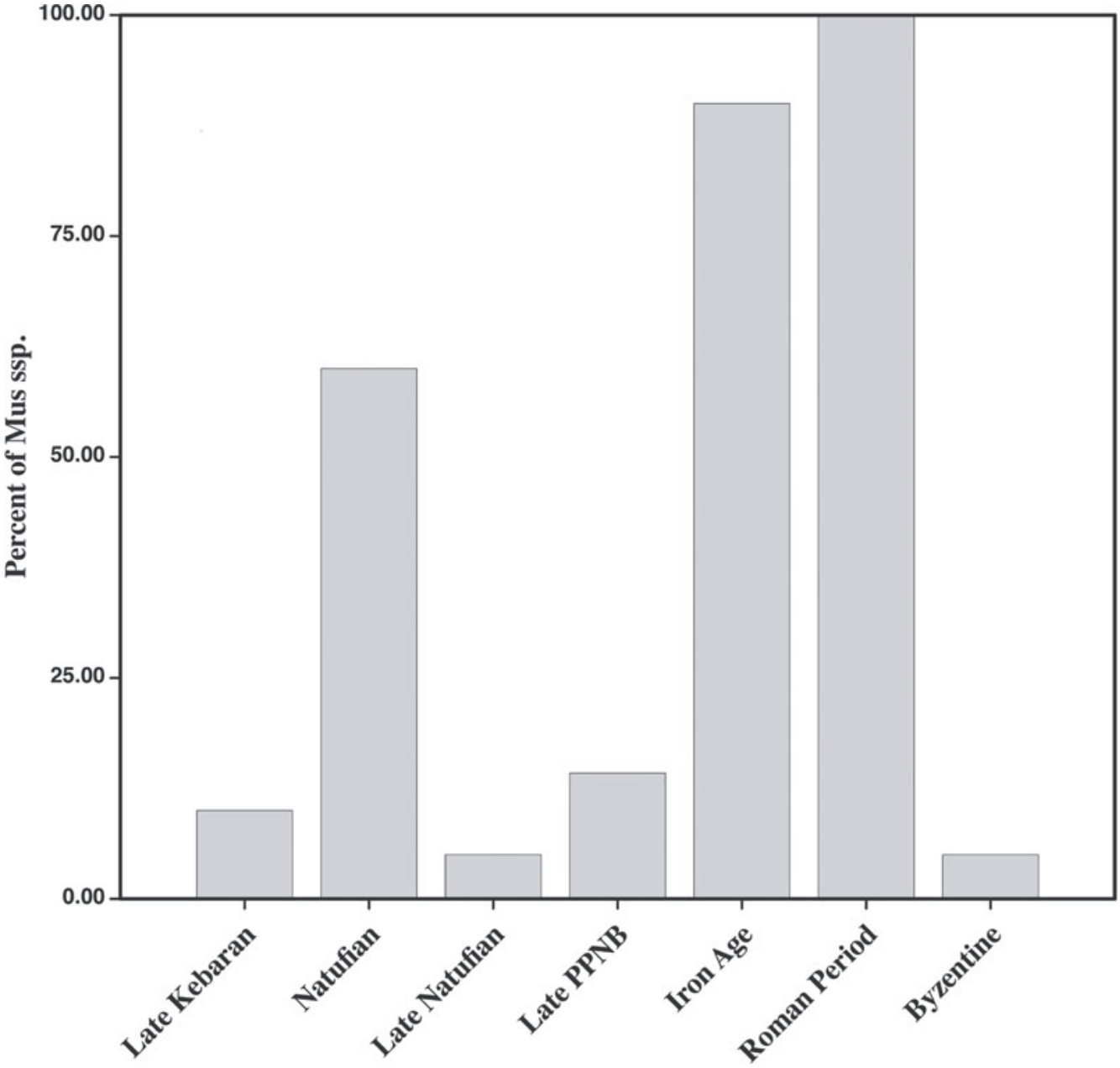

Fig. 2.1. Diachronic change in distribution of Mus *ssp. Late Kebaran from Ohalo II (Belmaker* et al. *2001); Early Natufian from Hayonim (Tchernov 2008); Natufian from Wadi Mataha (Baadsgaard* et al. *2010) and Hayonim B (Bar-Yosef and Tchernov 1966); Late Natufian from Rakefet (Nadel* et al. *2008), Iraq Ed-Dubb (Edward and Martin 2007), and El-Wad Terrace (Weissbrod* et al. *2005; PPNA from Iraq Ed-Dubb (Edward and Martin 2007), Late PPNB from el Wad (Weissbrod* et al. *2005), Bronze Age and Iron Age from Tel Megiddo (Weissbrod* et al. *2014), Roman Period from Bethsaida II, this paper and Byzantine from Huqoq, this paper*.

The pattern apparent in the current data may be the result of the invalidly of the model, or a pattern obstructed by taphonomic biases. The paper will review the validity of the model that commensal species evolved from local wild progenitors in the Levant and therefore we should expect to find a correlation between the proportion of commensal species and degree of sedentism *i.e*. the more sedentary the habitat the higher the proportion of commensal taxa are found.

This paper will focus on three main issues that were not addressed in the original publication(s):

The updated genetic and paleontological origin of commensal species, the definition of commensalism and the taphonomy of the accumulation of commensal species in archaeological sites. This will allow us to discuss if using the abundance of commensal taxa is an appropriate model for sedentism in general and for early sedentism in particular and if given new data on the origin of the species, can we expect such a model to occur?

The genetic and paleontological origin of commensal species

According to the model proposed by Tchernov (Tchernov 1984b, 1984c, 1991a), the three main commensal species *Mus musculus domesticus*, *Rattus rattus* and *Passer domesticus* evolved during the Natufian from local wild progenitors. Based on paleontological identifications at the time, *Mus musculus domesticus* evolved from a local *Mus musculus*; the commensal *Rattus rattus* from a wild *Rattus rattus*, and *Passer domesticus* from the wild *Passer domesticus*. The wild forms were all assumed to have been known in the region since the early Pleistocene and even earlier.

Since the publication of the original model, new paleontological and genetic data have come to light, allowing us to reevaluate this model. There has been much research on the dispersal of these taxa from the Levant into western Europe flowing the dispersal of humans (Aplin *et al*. 2011; Cucchi and Vigne 2006; Cucchi *et al*. 2002; Ericson *et al*. 1997; Kovacs 2012; Vigne and Cucchi 2005). These species evolved to be totally dependent on humans and in later stages of human history become excellent markers of human dispersal. This paper deals with the early origins of commensal species during the transition to early sedentism and not about the spread of these species after sedentism had been established.

*House mouse (*Mus musculus domesticus*)*

Three species of wild mice occur across western Eurasia and North Africa: *M. spretus*, *M. spicilegus* and *M. macedonicus* or *M. spretoides* (Bonhomme *et al*. 1983; Boursot *et al*. 1993). The fourth species is the commensal species *Mus musculus*. *Mus spretus* is distributed in west Europe and North Africa, *M. spicilegus* is distributed in southern Russia and the Balkans, and *M. macedonicus* is distributed is Greece, Macedonia, Anatolia, the Caucasus and the northern Levant. The most southern distribution of *M. macedonicus* is the Mediterranean zone of the southern Levant. The house mouse is widely recognized as a polytypic species containing at least three distinctive lineages considered as subspecies: *Mus musculus musculus*, *Mus musculus domesticus* and *Mus musculus castaneus* (Auffray *et al*. 1986).

The earliest identification of the genus *Mus* in the Levant is from ‘Ubeidiya in Israel, dated to 1.6 mya (Tchernov 1986). Given the difficulty in identification to species based on fossil morphology alone, it is difficult to ascertain to which species they belong. Specifically, identification of *Mus musculus vs. Mus macedonicus* in the fossil record is difficult. Originally, identification was solely based on the zygomatic bone in complete skulls. Thus, the malar process at the upper base of the zygomatic plate is wide in *M. macedonicus*, but narrower in *M. musculus* (Auffray *et al*. 1990a). Prior to 1990, many of the older studies had identified many of the *Mus* specimens dating to the Early and Middle Pleistocene in the region as *Mus musculus* (Tchernov 1975). Based on this, it would appear reasonable to hypothesize that the evolutionary origin of *Mus musculus domesticus* was a local wild *Mus musculus* (Bar-Yosef and Tchernov 1966).

After the publication of Auffray *et al*. (1990a), a reanalysis of many of the sites was preformed

which suggested that *Mus* remains in Oum Qatafa (400 kya), Qafzeh (100 kya), Tabun D (*ca*. 180 kya) and Tabun C (*ca*. 100 kya) should be identified as *Mus macedonicus* (Auffray *et al*. 1990b). With the advent of geometric morphometric studies, differences between the two taxa were found in molar morphology (Cucchi *et al*. 2002; Vigne and Cucchi 2005), which was since used to confirm the identification of the two taxa in early sites.

The earliest evidence for *Mus musculus* was found in a layer of Hayonim B cave dated to 10–11 kya (Auffray *et al*. 1988). Of all the species of *Mus*, only *Mus musculus* evolved a true commensal way of life. The origin of the species *Mus musculus* is in India (Bonhomme *et al*. 1983; Boursot *et al*. 1993). The three subspecies of *Mus musculus* diverged *ca*. 100 kya from each other and developed commensalism independently. Thus, if *M. musculus* first appears in the Southern Levant in Hayonim B, it cannot be derived from a local wild population of *M. macedonicus* present in the Epipaleolithic. Moreover, modern genetic studies have indicated that the *Mus* populations in the Levant include *Mus macedonicus* and *M. musculus domesticus* (Macholán *et al*. 2007). The latter is often feral *i.e*. a commensal species which is no longer commensal (Auffray *et al*. 1986). Therefore the only wild progenitor present in the Epipaleolithic in the Levant is *Mus macedonicus*, which cannot genetically be the ancestor of *Mus musculus*.

If indeed the Epipaleolithic population of *Mus* genus in the Southern Levant was *M. macedonicus* and not *M. musculus* as previously assumed (Tchernov 1975), the origin of commensalism might have been competitive exclusion between *M. macedonicus* and *M. musculus*. This would suggest that it was not a pattern of sympatric speciation as suggestion by Tchernov but a pattern of allopatric speciation in which a new taxon (*M. musculus*) migrated into the region and created a new competitive scenario.

The importance of understanding the selective forces, which operated on the early *Mus* species in the evolution of *Mus musculus domesticus*, are crucial in our hope to use them (if possible) as a proxy for the early stages of sedentism. It has been shown that the rate of allopatric speciation is slower than in sympatric speciation (Yukilevich 2014). We can test if the sympatric model may be applied to commensal species by observing the diachronic changes in the proportion of a species (Fig. 2.1).

Thus, if *Mus musculus domesticus* evolved as a result of increasing positive selective pressures stemming from human habitats, we would expect a rapid increase in the new commensal taxon. If on the other hand, *Mus musculus domesticus* evolved as a result of ecological exclusion with another species and chose human habitat as a results of exclusion from a preferred habitat, it may not serve as a robust proxy until the species is very established and be a poor proxy for the early stage of sedentism. Specifically, that the rise in abundance (and the appearance of the taxon) will be slow.

We are not implying that an allopatric model negates the existence of a new type of permanent anthropogenic structure developed during the Natufian that was providing the new ecological niche for rodents and passerines in the Southern Levant. However, we know today that this is not the first evidence for sedentism. Other evidence for sedentism such as storage, collection of grain appear much earlier in the archaeological record. To whit, dates for the earliest pottery are from Xianrendong Cave China, dated to 20 kya and suggest storage in hunter-gatherer societies (Wu *et al*. 2012). Evidence for extensive gathering of grain come from Ohalo II dated to *ca*. 23 kya (Weiss *et al*. 2004; Weiss *et al*. 2008). If the appearance of *Mus* does not correlate with these earlier phenomena, then we need to ask what it does correlate with.

*Black rat (*Rattus rattus*)*

Today the black rat, *Rattus rattus*, is the most widely distributed of all commensal animals and the most destructive of all animal pests (Aplin *et al*. 2011). Therefore, it may be tempting to assume that evidence for black rats should be correlated with the advent of sedentism. However, the first black rats in the Levant date to the Byzantine period where it has been found in small numbers from Caesarea (Cope, pers. comm.) and from Bethsaida II.

Identification of early Paleolithic fossils of *Rattus rattus* is difficult given its similarity to *Arvicantis ectos*, both in size and morphology. Tchernov (1994) suggested that the genus *Rattus* was present in the Levant from the Middle Paleolithic period. He identified the endemic species *Rattus haasi* in the Judean Hill cave of Oum Qatfa (400 kya), and that the species *Rattus rattus* was found in the region since the Kebaran period (17 kya). However, both these identification have been questioned (Kovacs 2012).

Throughout the literature (Belmaker *et al*. 2001; Nadel *et al*. 2008) several other authors have identified *Rattus* sp., prior to the historical time period. However, these identifications were only from postcranial remains. These postcranial remains are very similar to the African Cane Rat, *Arvicantis ectos*, which inhabited the region since prehistoric times. Without dental remains to secure the identification, it is difficult to ascertain the presence of *Rattus rattus* based only on a small number of specimens per site. It would appear that it most probable that this early identification of *Rattus* should be re-identified as *Arvicanthis* instead which were common and readily identified by their molars.

The initial diversification of the genus *Rattus* is known to begin at 3.5 mya and involved divergence into four lineages (Aplin *et al*. 2011). Three lineages (I–III) form a monophyletic group. The *Rattus rattus* Complex is the smallest monophyletic unit which include all typical black rats (which include several recognized species) and which has its origins 1.0 mya (Aplin *et al*. 2011). Of the four lineages, Lineage I shows good fidelity with populations commonly identified as *R. rattus*, including rats from European and Indian localities. The palaeontological and archaeological records of the Middle East and Europe suggest a possible late Pleistocene migration of Black Rats from India to the Middle East (although there is no appearance in the smaller area of the Levant *sensu strictu*). Remarkably, all other Lineage I haplotypes, which were detected outside of western India appear to be derived from a single emigrant haplotype dubbed the "out of India" haplotype (Aplin *et al*. 2011).

Given the presence of a Pleistocene population of *Rattus rattus* in Egypt and Arabia, the question of the timing of the arrival into the small region, which includes Lebanon, Syria, Jordan, Israel and Palestine, has been debated. As suggested above, there is no evidence that *Rattus rattus* dispersed northwards until the late historic periods, perhaps as late as the Byzantine period, and perhaps correlated with the appearance of the plagues.

Once the black rat arrived in the Southern Levant, it quickly became a pest, as attested to by the high number of black rats in Crusader Caesarea (Cope, pers. comm.). However, it is hard to argue that *Rattus rattus* were one of the animals that can be actually used as evidence *for degree of* sedentism as they only arrived after urbanism was in full development. Once arrived in a region, they fill a commensal niche. However, similar to *Mus*, they did not evolve from a local wild non-commensal progenitor.

*House sparrow (*Passer domesticus*)*

Genetic and paleontological data have shown that the house sparrow became associated with human societies around 10,000 BP (Sætre *et al*. 2012). One of the subspecies *P. d. bacterianius* still maintains the ecology and behavior of the wild progenitor indicating that the main changes between the wild and commensal species are the shift between migratory to residential status and a shift in beak shape which allowed for the consumption of larger seeds usually associated with domestication (Riyahi *et al*. 2013).

From a paleontological perspective, it is difficult to determine when the earliest wild populations of *P. domesticus* (or progenitors) are found. Avifaunas are rare in the archaeological record and when they are found, Passerines are rarely described. The fact that the earliest mention in the Near East of *Passer domesticus* is at Oum Qatafa in the Lower Pleistocene may well be a sample bias.

Tchernov (1979) identified *Passer praedomesticus* (which was cited as *Passer domesticus* in Tchernov (1962)) in Oum Qatafa (400 kya), he later cited *P. domesticus* at Hayonim B (10 kya) as well. While *P. domesticus* was also identified in the middle Paleolithic layers of Kebara (Tchernov 1962), the fragments were later re-identified as *Patronia patronia* (Tchernov 1979).

Since we only have two datum points it is difficult to ascertain the point in time at which the evolution of *P. domesticus* occurred from the putative wild progenitor, *P. predomesticus*. If indeed it occurred prior to Hayonim B, it occurred despite the fact that the inhabitants were hunter-gatherers and therefore did not inhabit the site for more than a season or two. After 6,000 BP, *P. domesticus* experienced a wide range expansion and dispersal, probably in relation to human expansion; although by then human sedentism and even urbanism were well developed (Ericson *et al*. 1997).

In summary, there is little data to show that the evolution of commensal forms occurred in the Southern Levant from local wild progenitors during the early stages of sedentism. *Mus musculus domesticus* probably arrived in the Southern Levant via a dispersal event from the east, probably India, around 12,000 BP. *Rattus rattus* only arrived later in the Byzantine period. Both probably arrived in a commensal form from India.

Commensalism appeared multiple times in *Mus* and in *Rattus*, and there is only genetic evidence in *P. domesticus* to supports a single origin of the domesticated form. Thus, while paleontological data support the appearance of commensal forms of *Mus* and *Passer* in the Levant 12–10 kya, it is not wholly supported by the genetic data and would suggest the reliance on the paleontological data, which susceptible to taphonomic and sampling biases, may warrant caution.

The ecological definition of commensalism

In the original model posited by Bar-Yosef and Tchernov (1966), three species were defined as those that were indicative of sedentism, *i.e*. species that lived close to human settlements, were dependent on them and therefore had developed a gene pool that differed from those of their wild ancestors and evolved into a new species. Tchernov (1984b) also indicated that other taxa might engage in commensalism including the Brown rat (*Rattus norvegicus*), *Acomys cahirinus*, and *Columba livia* (rock dove). If we agree that the model is indeed one of commensalism, we would expect a positive feedback loop *i.e*. low negative selection and high positive selection resulting in a high rate of evolution.

However, there are several other relationships between two species that have been described in ecology and that be more appropriate to the case at hand. Commensalism refers to a positive – neutral relationship. In this case, one of the species benefits from the relationship (*e.g*. the commensal species),

while the other has no selective advantage and is neutral towards the commensal species, and neither gains or loses in the relationship (in this case the humans). Can we argue that human do not gain nor lose in the presence of commensal species such as mice, rats, and sparrows?

We argue that this is not the case and that we need to find a different ecological relationship to better describe the relationship between early humans and mice, rats and sparrows. Defining the correct type of relationship will allow us to better model the tempo and mode of evolution from the wild progenitor.

Today, many of the commensal species that were named as indicators of sedentism, are rather known as *pests*, destructive animals that attacks crops, food, livestock, *etc*. Its etymological origin is from late fifteenth century French *peste* or Latin *pestis* meaning "plague", denoting the bubonic plague. With the development of large sedentary sites, the presence of rodents and birds would lead to infestation of the crops or food storage bins and could lead to epidemics of lethal diseases.

In the very early stages of sedentism, or even while humans were still hunter-gatherers, we can imagine wild species feeding off the refuse of humans. In this case, rodent populations that did so were *de facto* commensal while still maintaining a wild gene pool would not cause harm to the human population, since they were in low densities and humans were not storing food in large quantities. In this situation, species would have altered their gene pool from the wild progenitor only slightly if at all and not enough to constitute a new biological species.

However, if we accept that these processes lead eventually to a full gene pool separation between the wild population and a population that depend solely on human habitations, then the species fully dependent on human habitations would no longer be commensal but would become a pest. Even if humans are at this stage were still hunter-gatherers, having populations of animals that feed off their refuse and food stores would have increased their disease load to humans and reduced storages of food.

If indeed these species are pests and not commensal, what does it say about the rate of evolution? The feedback loop may include negative selection exerted by humans including attempts to exterminate them and resulting in a much slower and a much less predictable process of evolution.

The lack of linear relationship observed in Figure 2.1 between relative abundance of "commensal" species and the intensity or degree of sedentism may be that the evolution is not that of commensalism but of pest and in which we need not expect a linear relationship at all. It is not that the proportion of *pests* (*sensu strictu*) cannot be used as a proxy of its own, but we need to reevaluate what that proxy is.

Taphonomy

The new genetic evidence and a critical view of commensalism, suggests that the original model regarding the origin of the commensal species may need to be revised. Evidence presented suggests that our current data on the abundance of *Mu*s does not support the expectations derived from this model.

However, there is another factor which may hinder our ability to test the data. Thus, the reason for the observed pattern in the fossil record of the lack of clear relationship between the abundance of commensal taxa and sedentism is the taphonomic origins of each of the many assemblages compared.

The original model (Tchernov 1984b, 1991a, 1991b) was criticized by Tangri and Wyncoll (1989) who argued that taphonomic factors and sampling are more important in the determination of the

relative frequency of species than intra species evolution which would occur during the evolution of commensalism. We concur.

Small mammals (mice and rats) as well as small birds (sparrows) are most often accumulated in archaeological and paleontological sites *via* predators, either raptors or carnivores. This is true for both prehistoric and for historic urban sites. Rodents and birds rarely die from natural causes in their nests and burrows (Andrews 1990).

Raptors, the most common accumulator of microvertebrates in archaeological sites, need specific conditions to deposit their pellets in an archaeological site. For rodents and sparrows to be accumulated in this way, barn owns need to roost or nest in the area. They require a place which is closed overhead, and which has a ledge or place for the nest. Good places are caves, abandoned houses and most often barns (hence the name barn owl), or tree holes, but they cannot roost or nest in an open space. To allow for the extended accumulation of pellets, they require a long time period of time in which they can return to the same place over and over again to roost (Andrews 1990).

The main source of taphonomic bias is the type of predator/raptor responsible for each accumulation. Thus, some predators are specialists and focus on one type of prey species (*e.g.* vole specialist), one type of prey size (such as barn owls) or preferred hunting habitat (Eagle owls prefer to hunt in woodlands) and as a result different predators do not sample the environment equally. Understanding this pattern, we can understand the difference in raptor sampling among different pre- and post- sedentism situations. There has been a long discussion in the literature if the most common accumulator of microvertebrates, the barn owl, is a generalist or a specialist. If it is a generalist, than it is assumed to sample it the species that live in its environment randomly. However, if it is a specialist, it will sample a particular species in a proportion above its abundance in the environment. Tchernov (1984b) assumed that the preference for preying in certain habitats and on certain prey exhibited by *Tyto alba* was consisted and random across the environment, however, research has shown that barn owl are vole specialist and while they are good predictors of the rodent species in the habitat if quantified using presence-absence models they are poor proxies for the abundances of the rodents (Belmaker and Hovers 2011). Thus, according to Tchernov's model, an increase in relative abundance is an indicator of sedentism. However, such an increase could very well be solely an artifact of taphonomic bias.

In prehistoric time, human often inhabited caves. When humans abandoned the cave, raptors or carnivores could inhabit the cave and deposit pellets and scats, often containing remains of microvertebrates. The microvertebrates were deposited from a radius surrounding the cave, reflecting the hunting range of the predator. In urban societies, raptors and carnivores are also the main accumulators of microvertebrates. Barn owls inhabit rooms; barns and structures that are abandon by humans and deposit their pellets there. Carnivores, mostly domestic dogs and cats, can consume pests and deposit scats in courtyards or abandoned rooms. The range in which mammalian carnivores obtain the prey is mainly within the city while agricultural fields and surrounding terrain are the main range for avian raptors.

It is important to characterize the site sampled when we are studying sites from the earliest stages of sedentism. Is it a cave site like Hayonim B or an open-air site like Tepe Ganj Dereh? Is there full development of agriculture, which would lead to a higher proportion of pests in the faunal record? Is the predator responsible for the fossil accumulation of microvertebrates one whose prey tends to be

biased towards one size?

We would assume that if the role of taphonomy were minimal in determining the abundance of a specific taxon such as *Mus* that we will have similar proportion of this species across sites in the same period and the same types of sites (habitation, burial). If we observe intra site variability we can see that different loci have different proportions of *Mus*. For example, in the Late Natufian of el Wad Terrace, the proportion of *Mus* ranges from *ca*. 9% to above 22%.

However, the type of site also makes a difference. If we compare the proportion of *Mus* between two Natufian sites that different types of sites for humans: Hayonim Cave was a habitation site and Raqefet is a burial site. The proportion of *Mus* at the Hayonim B cave is very high around 60%, those in the cave at Rakefet are low and closer to 15%.

Thus, both type of site and taphonomy codetermine (possibly with other factors), the proportion of *Mus* in the assemblage. Taphonomic analyses have shown that the Eagle owl was a likely contributor to the assemblage at Rakefet (Nadel *et al*. 2008). Eagle owls are known to prefer hunting in woodland with a low percent of commensal prey, as compared to barn owls that prefer to hunt in open grassland (and agricultural fields) (Andrews 1990), with a higher percent of commensal prey (Charter *et al*. 2009). While the taphonomic accumulator of Hayonim B is unknown, if it included other predators than the Eagle owl, the difference in the dominant predators at the two sites may also explain the difference in the microvertebrate accumulation between Hayonim B and Rakefet in addition to site type.

Another issue is that many archaeological sites, especially in the Natufian and Neolithic periods are not cave sites, which are commonly inhabited by owls, but neither are the urban sites which provide artificial caves *i.e*. abandoned rooms in which raptors can shelter. They provide a complete different taphonomic challenge. For raptors to contribute to an assemblage, there has to be some form of ledge, tree or house structure at the site, even for part of the year. If not, it often results in a very small sample size; very sensitive to sampling biases and in which variation among sites is greater (Magurran 2003).

Tchernov uses the abrupt rise in proportion of commensal taxa as an indicator for sedentism. In one case, he points out that *Passer domesticus* constitutes over 40% of the avifauna of the Natufian of Hayonim (Tchernov 1984a). However, such high proportions are common with raptor assemblages, which tend to be specialists and are not indicative of the environment *i.e*. niche separation (Andrews 1990; Belmaker and Hovers 2011; Tores *et al*. 2005).

To summarize, differences in taphonomy may explain much of the discrepancy between the expected pattern according to the model presented (*i.e*. an increase of commensal species with sedentism) and the observed model (*i.e*. no clear relationship between increase in commensal species and sedentism).

Discussion and conclusions

A direct and linear relationship between humans and commensal populations with the degree of sedentism of man may be difficult to establish with the current data. This may be the results of an invalid model or the effects of taphonomy. The model presented originally by Tchernov (1984b) was based on a sympatric evolutionary model (Dieckmann and Doebeli 1999), which suggested an evolution of commensal taxa from within local wild progenitors. If commensal taxa evolved *via* a

different model or if the model is inherently different, then we need to look for different variables when studying the issue of early sedentism.

Specifically, of the three species that have been used as the hall mark for the advent of sedentism, *Mus musculus domesticus* can be shown both paleontologically and genetically to have appeared *ca*. 12,000 BP in the Levant. The genetic evidence for the origin of *Passer domesticus* suggests it origin 10,000 BP but there is little paleontological evidence to confirm this date. The paleontological origin of *Rattus rattus* can only be attributed to the historic period and the genetic evidence suggest that its origin is much earlier, indicating that it is difficult to pinpoint the origin of the commensal form.

However, our archaeological understanding of sedentism has been pushed back earlier and earlier in time. In the original publications, the evolution of commensalism was attributed to the new niche developed by human habitation, storage and gathering of food. As research progresses, some of these features of sedentism have been pushed back earlier in time.

Thus, if the Natufian (13,000–9,800 BC) was previously considered to include all the hallmarks of sedentism, now several of the hallmarks of sedentism appear in the earlier Epipaleolithic. Thus, in the site of Ohalo II, the appearance of huts and extensive gathering of grain as has been dated to 23 kya. A micromammal analysis of Ohalo II suggests that the main accumulator is the Barn Owl. While there are only brush huts in Ohalo, it suggests that the building of ephemeral structures may allow for raptor roosting and pellet deposition after people have abandoned the site (Belmaker *et al*. 2001). Should these buildings be considered as evidence for sedentism?

The appearance of many of these behavioral manifestations of sedentism occurred with no evidence for *Mus musculus* and a very low overall density of rodents suggesting that in this case, we could not have used microvertebrates as a proxy for sedentism. Was sedentism not occurring in Ohalo II? Perhaps not to a degree that was enough to develop commensalism, perhaps not enough time lapsed. Was there not enough storage or grain to *de facto* create a new niche? This is hard to imagine given that over 100,000 plant specimens were retrieved (Weiss *et al*. 2004, 2008). The unique case of Ohalo II suggests that how we define the parameters of sedentism will change the parameters we use as its proxy.

Thus, there are two issues regarding the validly of the original model proposed. The first, the species use and the second when do they become truly commensal. Thus, we have shown that of all taxa, only *Mus* can serve as a proxy for the early stage of commensalism in the Levant. In addition, the data available to scholars mining the literature today does not support the idea that the increase in *Mus* occurred in the Early Natufian. Following the decrease in *Mus* in subsequent stages of the Natufian, we need to ask what speciation model can explain a gradual rather than abrupt increase in *Mus*. The original model proposed by Tchernov (1984a) suggested a local evolution from a local wild progenitor. The genetic evidence suggests that the evolution was a sympatric one and based on incoming populations. Much more testing is needed to determine if this new taxon, *Mus musculus*, appeared it the region already commensal (and thus we need to look for the origins of commensalism elsewhere) or in a wild form.

Does it matter if we call rodents and sparrows "commensal" or "pests"? We can expect different rates of evolution as the relationship between humans and the rodents' changes from "commensal" to "pests". Commensal species do not harm humans. They only provide a positive feedback to the commensal organism, thereby increasing the rate of evolution of early house mice, rats and sparrows.

By contrast, pests have a negative impact on humans, thereby producing a negative feedback loop on the rate of evolution on these taxa. This would have altered our expectation of the relationship between relative abundance of these taxa since their first appearance and the level of sedentism.

Thus, the second issue that is evident from this study is that even if we wish to test the validly of the two models and how our predictions may differ regarding *Mus* populations in archaeological sites, taphonomic factors obscure the pattern we may observe.

Why do some sites have a high proportion of some taxa and not others? The type of site, cave *vs*. open air, usually provide a big difference in the basic taphonomic history of the assemblage. Furthermore, the habitat and region in which the site was found is equally important. Thus, analyses should be vigilant to compare apples with apples and oranges with oranges. Comparing assemblages that were accumulated by barn owls is not comparable to those accumulated by other modes of accumulation as each has their own unique biases towards specific species.

A case in point is trying to compare different urban sites. Not all urban sites exhibit a high proportion of rodents. If microvertebrates were a true archaeological proxy for the degree of sedentism we should expect to find them in high proportions in across sedentary sites, however a more complex pattern emerges. Comparison of micromammal communities across urban and rural sites suggested depressed species richness in urban sites compared to rural sites with the proportion of various taxa related to various modes of settlement and abandonment (Weissbrod *et al*. 2014). Thus, high density of microvertebrates in the sediments in some urban societies and the high proportion of *Mus musculus domesticus* among the microvertebrates can differ widely. For example, Bethsaida II (Roman period), which has a very low density of microvertebrates overall (a total of 11 specimens for over 30 l of soil) included 100% of *Mus musculus*. In contrast, an assemblage in an abandon Meqwe in Huqoq dated to the Roman Byzantine period had a very high density of microvertebrate with over 200 specimens for 10 l of soil but less than 5% of *Mus musculus domesticus*. The differences have been attributed to high heterogeneity and patchiness of habitat structure (Weissbrod *et al*. 2014). We would argue that the taphonomic effects are underestimated and that they produce a far greater variability in the fossil record.

When we study the abundance of commensal taxa though time, we cannot ignore that they are absent from prehistoric sites and present in historic sites. The issue of how to interpret their abundance and presence in the several thousands of years between true hunter-gatherer prehistoric societies and true sedentary societies is complex. Some taxa like *Mus* were quick to utilize the new habitat and others more slow to do so. Eventually, they became a burden on humans, which in turn, did much to expel rodents and house sparrows from their sites. Had it been a true commensal population, we would have seen an ongoing increase in all sites. However, this is not the case.

There is a high inter- and intra-site variability in the percent of *Mus* during the early stages of sedentism. Thus, this paper suggests that presumptive commensal species should no longer be used as a sole marker for the onset of sedentism. It is difficult to pinpoint when there is an overall rise in *Mus* in microvertebrate assemblages. Furthermore, the high variability among modern assemblages suggests that ecological factors along site taphonomic ones may also determine the percent of *Mus* in any given assemblage.

Of importance is the fact that the high inter and intra variability makes it nearly impossible to pin point where along the temporal sequence of the Natufian do we see the rise in proportion of *Mus*.

Furthermore, there is no data from the critical Chalcolithic period, associated with the rise of urbanism to test the difference in mean between early sedentism and urbanism. However, while the average percent for Natufian samples is 22.4%, the average for post-Chalcolithic samples is 50.4%. However, given the variability among each group they do not differ statistically (Two tail student *t* test=−1.18 df=8 *p* >0.1). Thus given a single assemblage of an unknown time period, it would be impossible to determine what time periods it belongs to and what level of sedentism is associated with it. On note, there is also a high variability among modern data. This data is usually collection from pellets so it is analogous to remains found in archaeological sites. The variability among the abundances of different species within barn owl assemblage has been related to local ecology *i.e*. the phytogeographic zone as well as the type of agricultural crop (Fig. 2.2). The percent of *Mus* in the assemblage in some of the cases may be as low (5%) as archaeological assemblages that predate sedentism (such as Ohalo II).

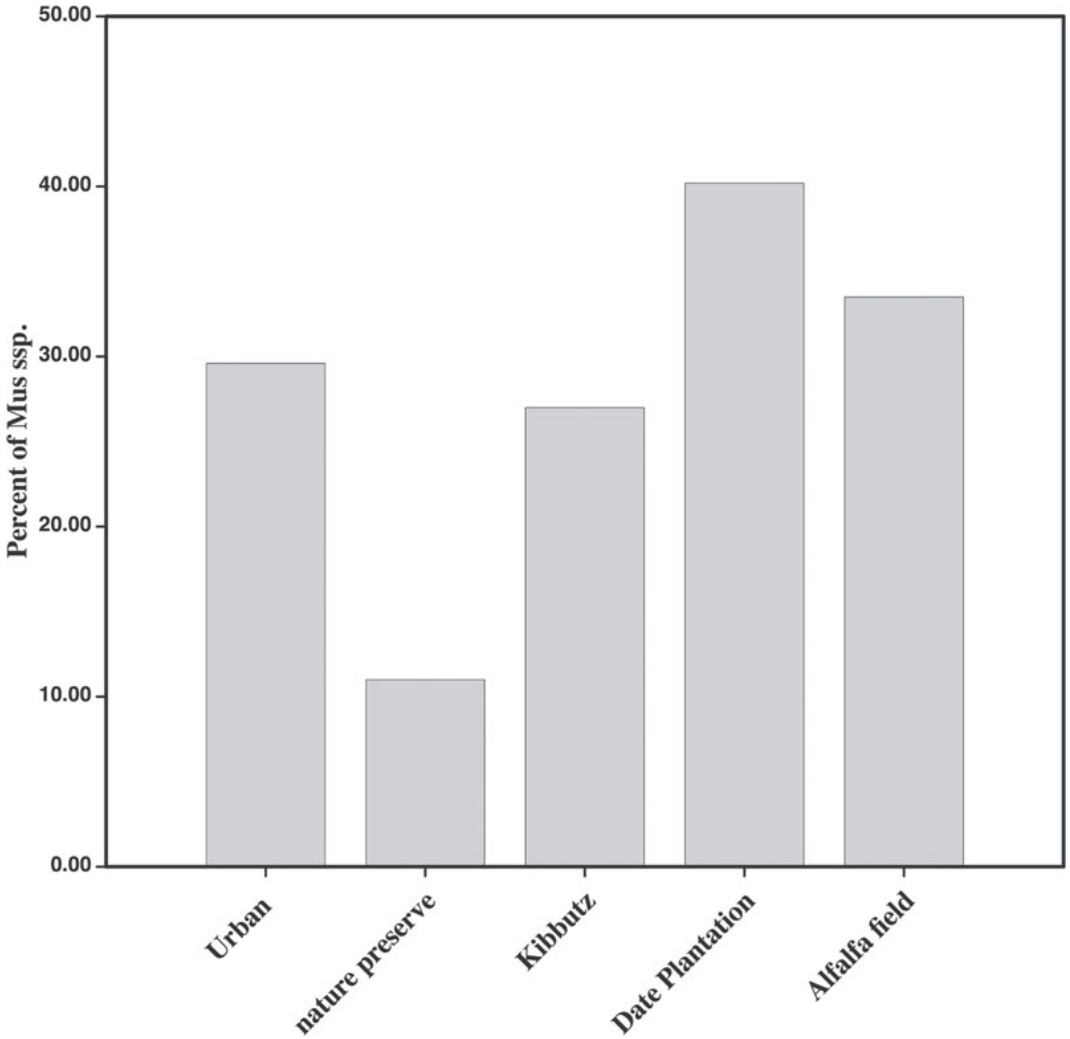

Fig. 2.2. Synchronic differences in Mus *ssp. abundance in modern barn owl pellets. Kibbutz, Date plantation and Alfalfa Plantation from Kibutz Sede Eliyahu (Charter* et al. *2009), Nature preserve data from El Wad (Weissbrod* et al. *2005); Tel Aviv, Israel (Charter* et al. *2009).*

Other markers that take taphonomy, community structure and biodiversity into account as additional variables are preferable as more robust proxies. While the use of community structure and biodiversity has proxies for early sedentism have been explored by Weissbrod *et al*. (2013). It has been argued that high taxonomic richness and heterogeneity are better markers than the percent of *Mus*

(Weissbrod 2013; Weissbrod *et al*. 2014), and are even better markers for urbanization *vs*. rural habitats after sedentism was commonplace.

It is important to note that other factors are also influential in the determination of the abundance of *Mus*. These include climate change, spatial and temporal changes in the habitat. Following the initial high proportion of *Mus musculus* found in Hayonim B, there is an apparent extinction of *Mus musculus* from the southern Levant, which now occurred in reduced numbers in Mureybet in the Euphrates valley. In has been suggested that this local extinction has been related to the Younger Dryas (Cucchi and Vigne 2006).

However, give the role of taphonomy in the accumulation of micromammals, we would caution against using these methods without taking possible taphonomic biases into account. Thus, it is important to verify the different taphofacies in the microvertebrate assemblage. It has been argued that several taxa (*Spalax* and *Sciurus*) may have an anthropogenic origin and thus need not be part of the raptor taphofacies, which often includes *Mus* (Weissbrod 2013). The nature of each taphofacies needs to be scrutinized.

In sum, of all the commensal species that have been used as sedentism markers, only *Mus* has modern genetic and paleontological evidence to support the appearance of *Mus musculus domesticus* in the Natufian in the Southern Levant. However, the exact evolution of the taxon, how it evolved and the selective pressures that allowed a pest form to emerge from a wild population remain unclear. Thus, we suggest that further testing of the model is warranted.

In addition, a very high inter and intra variability of *Mus* abundance among archaeological and modern sites does not allow us to pinpoint the time period in which the rise in *Mus* abundance became significant and thus we urge caution when using *Mus* abundance as an indicator for human sedentism.

Other archaeological evidence such as architecture, pottery and grain collection may serve as better proxies than microvertebrates or until better taphonomic analyses will allow us to distinguish between taphofacies with greater security.

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Chapter 3

Subsistence Strategies in the Aceramic Neolithic at Chogha Golan, Iran

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In this paper, we present preliminary zooarchaeological and archaeobotanical results from the aceramic Neolithic site of Chogha Golan (Ilan Province, Iran). The site was occupied between 12,000 and 9,600 cal BP, on the cusp of the domestication of plants and animals in the Zagros region, and elsewhere in the Fertile Crescent. Small samples do not allow us to address the domestication of animals at this time, but archaeobotanical studies indicate the appearance of morphologically domesticated-type emmer wheat at the site by 9,800 cal BP. The currently available floral and faunal data track at least two shifts in subsistence at Chogha Golan. Midway through the sequence, there was an increase in the exploitation of small-seeded grasses, along with more gazelle hunting. This could represent temporary resource stress, possibly driven by increased aridity in the area. At about 9,800 cal BP there was a second shift, with an increased importance of cattle and the previously mentioned appearance of domesticated-type emmer. These subsistence changes occurred in the context of a site that was a sedentary village millennia before domesticated species were utilized, which also reflects the regional situation. Chogha Golan adds to our understanding of the appearance of Neolithic lifeways, and suggests that domestication did not necessarily drive increasing social complexity, and that the origins of food production developed with a distinct regional signature we are still seeking to identify and explain.

Introduction

Southwestern Asia has a long history of archaeological research, particularly when it comes to the cultural and technological changes that accompanied the Pleistocene–Holocene transition. Many studies focus on the origins of plant and animal domestication, as Southwest Asia was a center of this significant development in human history. The Zagros Mountains and foothills of Iran and Iraq were key early on in our understanding of this topic, though more recent information has come from the

Levant and Anatolia. Systematic research of the Zagros largely began with Braidwood and colleagues (1961), who believed that the origins of domestication could be traced to the hilly flanks of the Taurus and Zagros Mountains. Many well-known Neolithic sites were excavated in the region over the course of the mid-twentieth century, including Abdul Hosein (Pullar 1990), Tappeh Ali Kosh (Hole *et al*. 1969), Tepe Asiab and Sarab (Braidwood 1960; Braidwood *et al*. 1961), Ganj Dareh (Smith 1974, 1976, 1978), Guran (Mortensen 1963), Jarmo (Braidwood and Howe 1960; Braidwood *et al*. 1983), Karim Shahir (Howe 1983), and Zawi Chemi Shanidar (Solecki 1963).

Early faunal studies that resulted from these excavations mainly focused on developing and applying different methods for understanding the origins of sheep, goat, and pig domestication (*e.g*. Bökönyi 1977; Flannery 1961, 1983; Hesse 1978, 1982, 1984; Hole *et al*. 1969; Perkins Jr. 1964; Reed 1959, 1961; Stampfli 1983; Turnbull 1983; Turnbull and Reed 1974; Uerpmann 1978, 1979). Many recent zooarchaeological works have returned to these previously excavated collections to apply new and updated techniques for addressing the question of domestication (*e.g*. Price and Arbuckle 2015; Zeder 1999, 2001, 2003, 2005, 2008a, 2008b; Zeder and Hesse 2000). Besides a few older reports on plant remains from Ganj Dareh (van Zeist *et al*. 1984) and Ali Kosh (Helbaek 1969), archaeobotanical data has been acquired from only a few recently excavated sites, such as Sheikh-e Abad, Jani (Whitlam *et al*. 2013), and East Chia Sabz (Darabi *et al*. 2013; Riehl *et al*. 2012). Based on these studies, along with projects in other parts of the Fertile Crescent and much recent genetic work, a complicated picture for the origins of domestication has emerged. It is clear that there was no single center for the domestication of animals in general, or even of individual species (Fernández *et al*. 2006; Larson *et al*. 2005; Naderi *et al*. 2008; Pedrosa *et al*. 2005), and indeed there was considerable variation in initial management strategies of early domesticates and proto-domesticates (Arbuckle and Atici 2013; Zeder 2008b). Despite the fact that some taxa were domesticated within a short time of one another, they were not initially universally adopted as part of some kind of Neolithic "package" (Conolly *et al*. 2011). Similarly there are several regions within the Fertile Crescent where domesticated plants appeared more or less simultaneously (Fuller *et al*. 2011). An important result of detailed archaeobotanical studies is the recognition of domestication rates, suggesting that domesticated species evolved over several hundreds of years as the outcome of cultivating wild taxa (Fuller 2007; Tanno and Willcox 2006).

While our understanding of the origins of domestication continues to evolve with new information from the Levant and Anatolia, as well as the critical reanalysis of sites in the Zagros, there is a limit to what we can glean from previously excavated sites. Most of the work at the classic Neolithic sites in Iraq and Iran was conducted in the mid-twentieth century. Though the projects were cutting-edge for the day, and it is extremely important that we have these collections and datasets to refer to, recovery methods at many of the early excavations were less than ideal. Techniques that are standard today, such as wet screening and sediment flotation for the recovery of botanical remains, were simply not done.

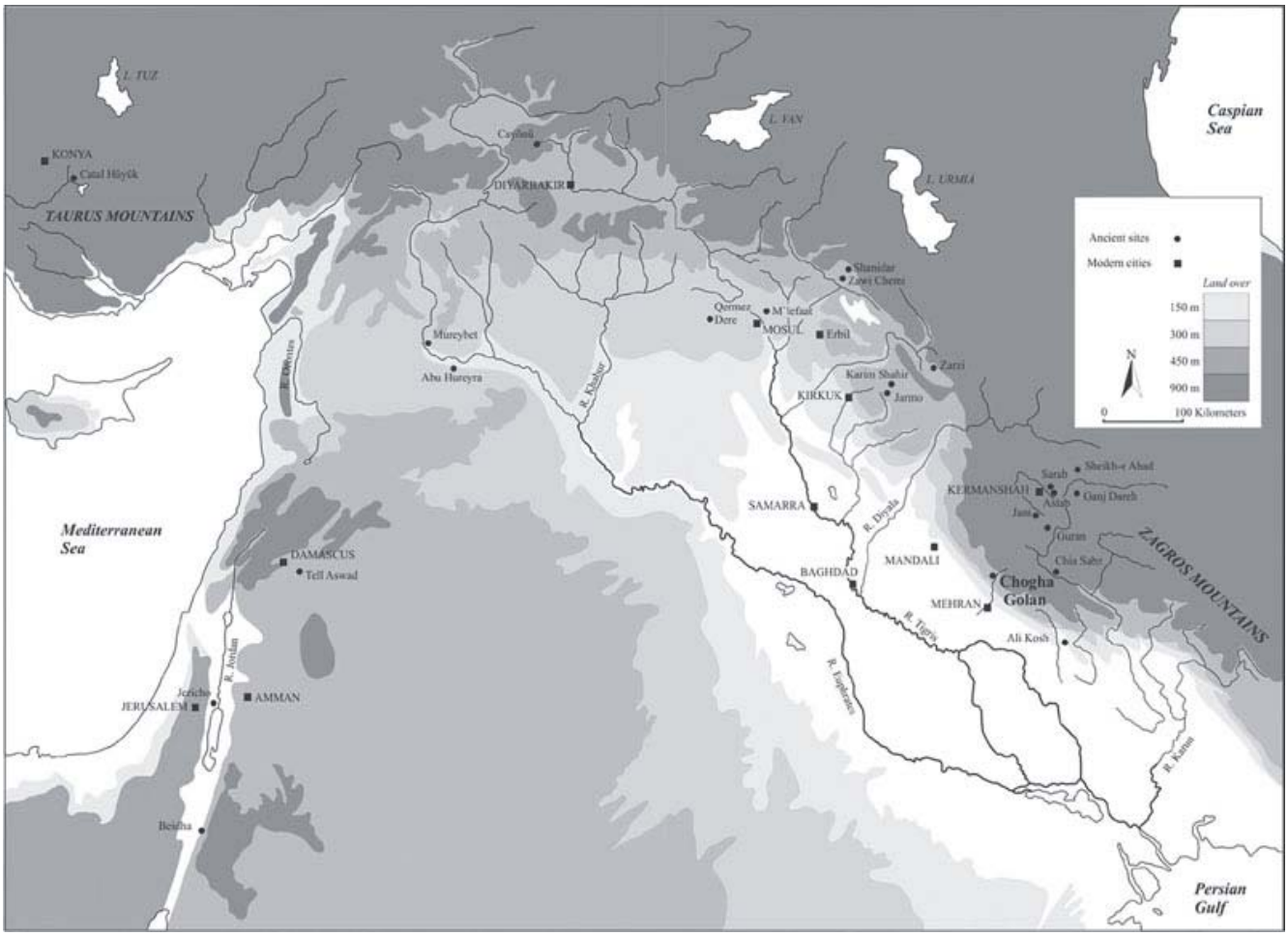

Fig. 3.1. Map of the Zagros region with sites mentioned in the text.

Recently, some new excavation projects, such as the Tübingen–Iranian Stone Age Research Project (TISARP, Germany/Iran) and the Central Zagros Archaeological Project at the University of Reading (United Kingdom), as well as some local Iranian projects, have begun to supplement previous excavations in the Zagros region with more thorough, modern techniques (see also contributions in Matthews and Fazeli Nashli 2013; Matthews *et al*. 2010; Niknami and Nikzad 2012; Zeidi *et al*. 2012). Improved methods allow us to incorporate previously unavailable lines of archaeological evidence, such as archaeobotanical and micromorphology studies, with faunal and lithic analyses. This paper presents the preliminary faunal and archaeobotanical results from Chogha Golan, Iran, which were recovered as part of TISARP. Radiocarbon dates place the occupation of the site between 12,000 and 9,600 cal BP, encompassing the period during which the domestication of key plant and animal species emerged in other parts of the Fertile Crescent. At this stage, the faunal sample is too small to directly address the question of animal domestication, though archaeobotanical results show the appearance of domesticated-type emmer wheat in the sequence by about 9,800 BP (Riehl *et al*. 2013). Interestingly, evidence for domestication does not appear at the site until nearly two millennia after it was first settled, so early occupants were operating at a level of increased social complexity even without the systematic production of cultigens. The purpose of this paper is to examine overall shifts in the representation of different animal species at the site through the occupation sequence, alongside high-resolution archaeobotanical data. These results are useful for evaluating possible environmental or demographic shifts that might have driven changes in the subsistence strategies at Chogha Golan,

which led to the development or adoption of domestication.

Background

Chogha Golan is a tell located 30 km north of Mehran in the foothills of the Zagros Mountains, adjacent to the Mesopotamian Plain (Fig 3.1). TISARP, in cooperation with the Iranian Center for Archaeological Research, excavated the site in 2009 and 2010 (Zeidi *et al*. 2012). It was discovered in 1993 during a survey project in anticipation of the construction of a dam (Khalilian 1999). The late A. M. Khalilian of the Ilam Antiquity Office formally surveyed the site in 1996; G. Nokandeh subsequently mapped the tell in 1999 (Nokandeh 2001). Chogha Golan lies 485 m above sea level, approximately 200 m from the banks of the Konjan Cham River. It is about two hectares in size and rises eight meters above the surrounding landscape. The region today is arid, with between 200 and 250 mm of annual rainfall.

The site contains an eight meter sequence of exclusively aceramic Neolithic deposits. There are eleven archaeological horizons (AH I–XI), which are often separated by plaster floors and other architectural features. Researchers excavated two trenches in 2009 and 2010, a 2 × 4 m area, and a 2 × 1.5 m deep sounding, which sits adjacent to a deep looter's pit in the center of the site (Fig. 3.2). Agricultural activities destroyed the surface of the site. Architectural features include stone, pisé, and mud brick walls, and ochre-painted plaster floors. Ample groundstone artifacts made of limestone and sandstone river boulders include hoes, *in situ* mortars, grinding slabs, handstones, pestles, and pounders (Fig. 3.3). The lithic assemblage includes tens of thousands of worked pieces and debitage (Fig. 3.3). Most artifacts are made from locally available grey chert, but other local materials, as well as obsidian from the Lake Van region of Turkey (800 km northwest), are also present. There is a gradual change through the sequence in the composition of tool types and raw materials. Other artifacts include shell and bone pendants, clay human and animal figurines, clay cones, stone beads, and grooved gypsum (Conard *et al*. 2013; Zeidi *et al*. 2012).

Seven radiocarbon dates that span the sequence place the occupation between *ca*. 12,000 and 9,600 cal BP (Table 3.1). Chogha Golan dates to a crucial period that predates and slightly overlaps with the appearance of plant and animal domestication in the Zagros. At Ganj Dareh (*ca*. 9,900–9,800 cal BP) and slightly later at Ali Kosh (*ca*. 9,500 cal BP), there is evidence for herd management of morphologically wild goats (Zeder 1999, 2008a; Zeder and Hesse 2000). Recent work at Jarmo suggests some level of pig management or protodomestication by the ceramic Neolithic, or possibly by the pre-pottery Neolithic, which dates to *ca*. 9,450–9,140 cal BP at the site (Price and Arbuckle 2015). So far no archaeobotanical assemblages from Iranian sites have been investigated for signs of pre-domestication cultivation. Domestic sheep appear later in the region (*ca*. 9,000 cal BP) at Tepe Guran, Sarab, and Jarmo (Zeder 2008a), while barley and emmer wheat – tentatively of the domesticated type – appear only from about 9,000 cal BP at Ganj Dareh and Ali Kosh (Helbaek 1969; van Zeist *et al*. 1984). Again, there is mounting evidence that sedentism and increased social complexity was in place well before intensified food production strategies in the region. A similar situation was initially identified by Jean Perrot, working on the Natufian in the Jordan Valley (Perrot 1960, 1966). Understanding subsistence and human-environment interactions at Chogha Golan is therefore critical to our broader understanding of the development and use of domesticated species in the Zagros, and how this relates to the region more generally.

Table 3.1. Chogha Golan. Radiocarbon dates and their corresponding AH layers. After Conard and Zeidi (2013).

AH	Sample description	Labcode	Years BP	Years cal BP	Years cal BC (2σ)
I	Charcoal	Beta-335608	8690±40	9637±54	7790–7600
II	*Triticum*-type	Beta-335610	8800±40	9831±82	8020–7750
III	Poaceae	Erl-14840	8805±38	9839±81	8181–7731
IV	*Hordeum*	Erl-14839	8887±37	10,037±94	8234–7938
VIII	*Hordeum*	KIA43836	9424±45	10,656±53	8814–8602
XI	*Hordeum*	KIA44944	9690±45	11,054±129	9274–9119
XI	*Hordeum*	KIA45647	10,125±45	11,740±187	10,042–9651

Methods

Fauna

The faunal sample in this preliminary presentation is from a 1 × 1 m unit from the deep sounding, which spans the length of the occupation (Fig. 3.2). This represents about a quarter of the fauna recovered during excavation from this area. At Chogha Golan, there is excellent preservation of floral materials, particularly in horizons XI–IV in the deep sounding, while faunal remains seem to be underrepresented. Consequently, all recovered faunal materials, including unidentifiable fragments, were recorded in order to fully understand the taphonomic history of the assemblage. Excavators screened all layers, selectively wet-sieving some based on their context (*e.g*. midden deposits) (Table 3.2). It is well-established that selective recovery can affect interpretations of faunal remains (Davis 1987: 28–31; Payne 1975), though we took efforts to combat such issues during analysis, which are discussed further below. Over 5,800 specimens were recorded, 1,620 of which are identifiable to species or body class and element (Table 3.3). In terms of less identifiable fragments (*e.g*. those that could only be assigned to the level of "medium mammal flat bone"), we simply counted, weighted, and recorded their burn and weathering stages. This subset of materials are actually the NUSP (number of unidentified specimens), but they are included in our data tables for their contribution to our understanding of taphonomic processes at the site. Microfaunal remains recovered from all layers of the excavation are not included in this analysis.

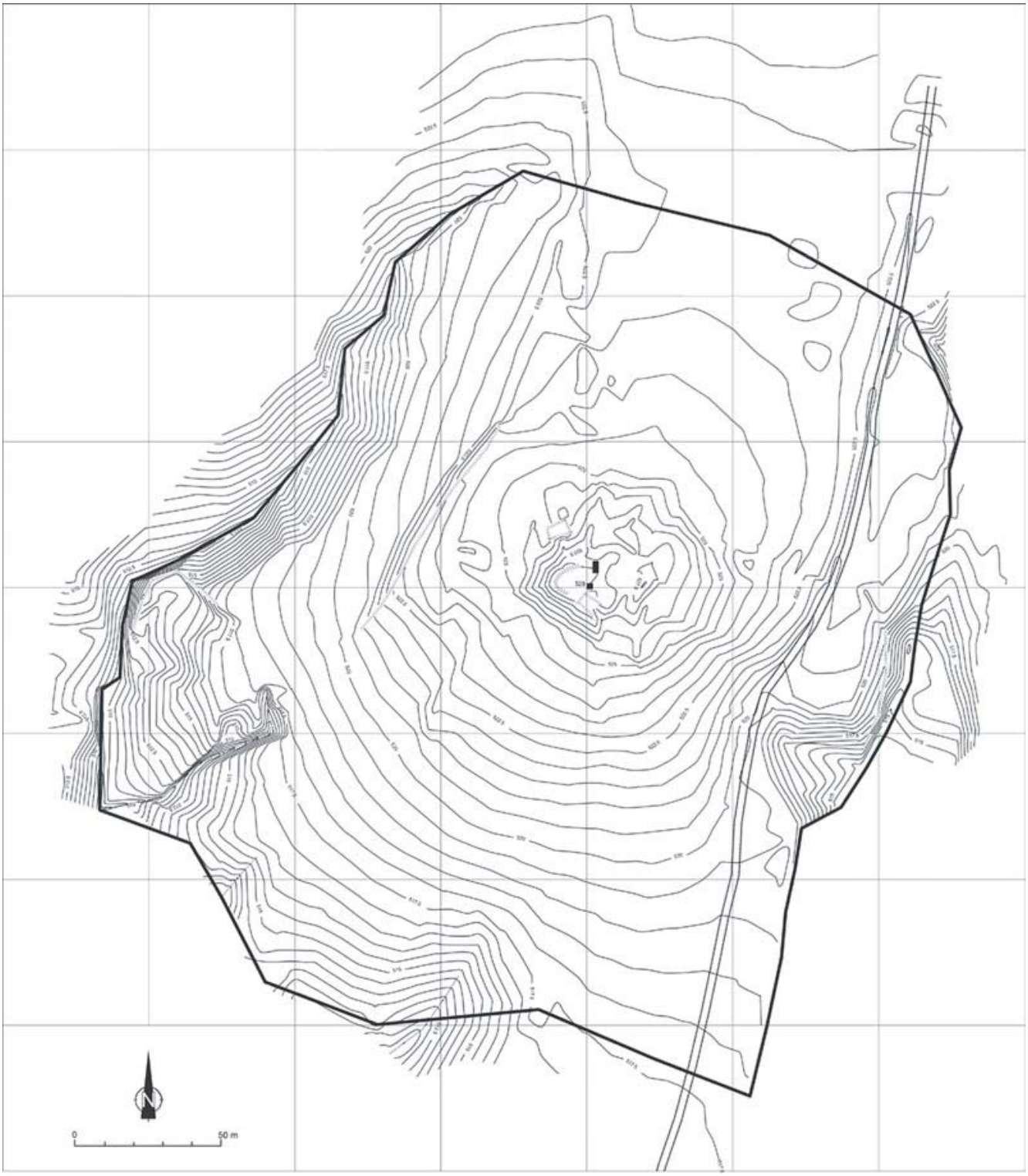

Fig. 3.2. Chogha Golan. Topographic map showing the extent of the site. Black boxes in the center of the tell indicate the excavation areas. The samples discussed in this paper are from the smaller excavation area to the south.

We identified faunal remains using the comparative collection in the Institute for Archaeological Sciences at the University of Tübingen. Documentation of the faunas follows standard zooarchaeological methods and counting units (*e.g.* Grayson 1984; Lyman 1994; Reitz and Wing 2008; Stiner 2005; Uerpmann 1973). All specimens were identified to the greatest precision possible (*e.g.*

genus and species, or to body size class for less diagnostic specimens). Documentation of natural surface weathering processes and damage follows Behrensmeyer (1978) and Fisher (1995). Observations such as rodent and carnivore damage, epiphyseal fusion, tooth wear, tooth eruption stages, and specimen length and mass were recorded when appropriate. Anthropogenic damage including cut marks, impacts or cone fractures from marrow extraction, and modifications as part of tool manufacture was recorded. Transverse fractures are defined as those that break the bone perpendicular to the long axis, and splits or spiral fractures occur when the bones are broken parallel to their long axis. Fractures are only recorded when they clearly took place when a specimen was fresh, or "green."

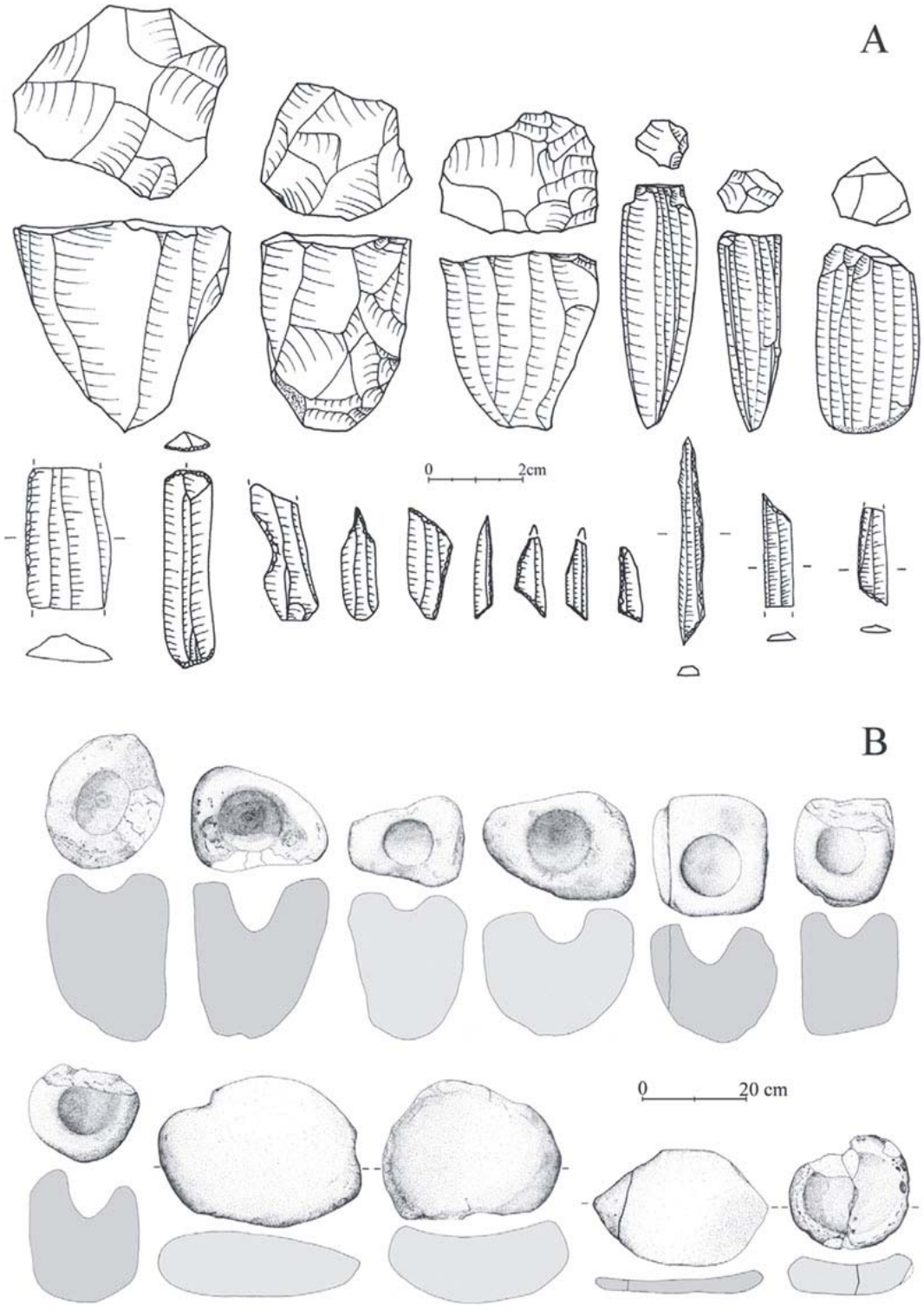

Fig. 3.3. Chogha Golan. A selection of (A) lithic artifacts and (B) groundstone tools. Modified from Conard and Zeidi (2013) and Zeidi and Conard (2013).

In many cases, number of identified specimens (NISP) is the preferred counting unit for analyzing faunal assemblages (see discussion in Lyman 2008: 27–38). However, as mentioned previously, different wet screening methods were applied to certain layers at Chogha Golan. Consequently, small specimens might be underrepresented in some layers, which has a disproportionate effect on small game elements. For overall trends in game use, particularly those that compare large and small animals, we turn instead to bone mass, which is also an effective and widely used counting unit (*e.g.* Barrett

1993; Reitz and Cordier 1983; Reitz *et al*. 1987; Uerpmann 1973). Our rationale behind comparing fauna in this way is that specimens recovered in the wet screens are too small to even register on a standard scale, whether or not they were from large or small game animals. Additionally, some scholars argue that bone weight is a more accurate measure of meat mass, and therefore the importance of certain taxa to the diet (Reitz and Cordier 1983; Reitz *et al*. 1987; Uerpmann 1973). For comparisons between small game taxa, NISP is still used because it is just as likely that different small game species were recovered from wet or dry screens, and their frequencies should not change relative to one another depending on the screening method.

Because the preliminary sample is small, individual taxa are collapsed into groups based on body size and predator evasion tactic (following Stiner *et al*. 2000): four sizes of ungulates, small carnivores, small fast, and small-slow moving animals (see Table 3.4 for species in each category). This allows for less diagnostic remains (*e.g*. medium ungulates) to be included in the analysis. At this stage, investigations of density-mediated attrition are not appropriate, but basic taphonomic data are presented. Material input rates for lithic artifacts, and floral and faunal remains are provided as a proxy for interpreting bone loss relative to other classes of materials.

Table 3.2. Chogha Golan. Find density for lithics and faunal remains from square 1/0 from the deep sounding.

Square	*AH*	*Volume (L)*	*% Wet screened*	*Lithics*	*Lithics per L*	*Bones*	*Bones per L*
1/0	I	965	0.00	1672	1.73	375	0.39
1/0	II	787	0.26	2099	2.67	1039	1.32
1/0	III	1073	0.26	3920	3.65	1026	0.96
1/0	IV	76	1.00	1012	13.32	752	9.89
1/0	V	286	1.00	1565	5.47	987	3.45
1/0	VI	62	0.35	151	2.44	130	2.10
1/0	VII	184	0.04	667	3.63	272	1.48
1/0	VIII	35	1.00	3573	102.09	605	17.29
1/0	IX	166	0.36	1322	7.96	571	3.44
1/0	X	58	1.00	2035	35.09	154	2.66
1/0	XI	455	1.00	NA	NA	72	0.16

Table 3.3. Chogha Golan. Species representation. Specimens only identifiable to small or medium mammals are not included as part of the overall percentages. Birds are all "medium birds" used in Figure 3.7.

	I		II		III		IV		V		VI	
Taxon	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*
Small ungulate	0	0.0	1	0.6	3	1.4	1	0.7	1	0.4	0	0.0
Gazelle	0	0.0	5	2.8	8	3.6	2	1.4	14	6.0	2	3.7
Small/medium ungulate	6	22.2	28	15.8	43	19.4	21	14.3	34	14.7	2	3.7
Medium ungulate	13	48.1	25	14.1	53	23.9	20	13.6	41	17.7	42	77.8
Sheep	0	0.0	0	0.0	1	0.5	0	0.0	2	0.9	1	1.9
Goat	1	3.7	7	4.0	16	7.2	1	0.7	0	0.0	1	1.9
Sheep/Goat	3	11.1	21	11.9	31	14.0	1	0.7	14	6.0	2	3.7
Medium/large ungulate	0	0.0	2	1.1	1	0.5	1	0.7	0	0.0	0	0.0
Large ungulate	0	0.0	0	0.0	2	0.9	0	0.0	7	3.0	0	0.0
Red deer	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
Pig	0	0.0	1	0.6	5	2.3	2	1.4	1	0.4	0	0.0
Large/extra-large ungulate	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0
Extra-large ungulate	0	0.0	0	0.0	1	0.5	1	0.7	0	0.0	0	0.0
Cattle	1	3.7	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0
Tortoise sp.	0	0.0	7	4.0	4	1.8	1	0.7	5	2.2	0	0.0
Turtle sp.	2	7.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Unidentified snake	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.9
Unidentified fish	1	3.7	74	41.8	43	19.4	94	63.9	96	41.4	2	3.7
Hedgehog	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0
Hare	0	0.0	0	0.0	3	1.4	0	0.0	0	0.0	0	0.0
Red fox	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0
Eurasian lynx	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
Small birds	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Medium birds	0	0.0	2	1.1	4	1.8	2	1.4	16	6.9	1	1.9
Large birds	0	0.0	0	0.0	2	0.9	0	0.0	0	0.0	0	0.0
Subtotal	27	100.0	177	100.0	222	100.0	147	100.0	232	100.0	54	100.0
Small mammal	34		38		42		140		131		27	
Medium mammal	311		777		775		465		609		46	
Total	372		992		1039		752		972		127	

	VII		VIII		IX		Xb		XI		Total	
Taxon	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*
Small ungulate	1	1.0	4	1.4	1	0.4	4	3.4	0	0.0	16	1.0
Gazelle	1	1.0	0	0.0	4	1.7	2	1.7	0	0.0	38	2.3
Small/medium ungulate	10	9.7	228	80.3	156	67.8	85	72.0	16	61.5	629	38.8
Medium ungulate	74	71.8	22	7.7	26	11.3	16	13.6	4	15.4	336	20.7
Sheep	1	1.0	5	1.8	2	0.9	1	0.8	1	3.8	14	0.9
Goat	0	0.0	2	0.7	3	1.3	0	0.0	1	3.8	32	2.0
Sheep/Goat	2	1.9	2	0.7	2	0.9	2	1.7	2	7.7	82	5.1
Medium/large ungulate	0	0.0	0	0.0	3	1.3	0	0.0	0	0.0	7	0.4
Large ungulate	1	1.0	2	0.7	1	0.4	0	0.0	0	0.0	13	0.8
Red deer	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1
Pig	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	9	0.6
Large/extra-large ungulate	0	0.0	2	0.7	0	0.0	1	0.8	1	3.8	5	0.3
Extra-large ungulate	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	3	0.2
Cattle	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.2
Tortoise sp.	1	1.0	0	0.0	3	1.3	4	3.4	0	0.0	25	1.5
Turtle sp.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.1
Unidentified snake	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	2	0.1
Unidentified fish	7	6.8	14	4.9	17	7.4	0	0.0	1	3.8	349	21.5
Hedgehog	1	1.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.1
Hare	1	1.0	0	0.0	0	0.0	0	0.0	0	0.0	4	0.2
Red fox	1	1.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.1
Eurasian lynx	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1
Small birds	0	0.0	0	0.0	2	0.9	0	0.0	0	0.0	2	0.1
Medium birds	2	1.9	3	1.1	9	3.9	1	0.8	0	0.0	40	2.5
Large birds	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	3	0.2
Subtotal	103	100.0	284	100.0	230	100.0	118	100.0	26	100.0	1620	100.0
Small mammal	18		74		71		10		31		616	
Medium mammal	143		222		247		26		15		3636	
Total	264		580		548		154		72		5872	

Flora

Over 700 sediment samples were floated at Chogha Golan between 2009 and 2010 using sieves with a

mesh size of 200 µm. To date, 25 archaeobotanical samples with more than 20,000 seed and chaff remains have been analyzed. The mean sample size is 10 l. We conducted identification based on morphological criteria using the botanical reference collection in the archaeobotanical laboratory of the Institute of Archaeological Science at the University of Tübingen using a Leica GZ6 binocular microscope. In total, we identified 117 botanical taxa. Basic numeric methods, such as percentage proportions of taxa and taxa groups and the ubiquity measure were applied to compare the assemblages of the different archaeological horizons.

The analyzed samples derive from the deep sounding and, while they provide an excellent comparison with the faunal remains and document detailed diachronic change at the site, they might not be spatially representative of the plant materials from the entire site.

Table 3.4. Chogha Golan. Taxa included in body size categories. Weight ranges from Nowak (1999) and Silva and Downing (1995).

	Weight range (kg)
Very large ungulate	
Aurochs (*Bos primigenius*)	500–1000
Large ungulate	
Red deer (*Cervus elaphus*)	75–340
Wild pig (*Sus scrofa*)	50–350
Medium ungulate	
Persian fallow deer (*Dama mesopotamica*)	50–120
Wild goat (*Capra aegagrus*)	40–90
Wild sheep (*Ovis* sp.)	40–90
Small ungulate	
Gazelle (*Gazella gazella*)	17–23
Small carnivore	
Eurasian lynx (*Lynx lynx*)	8–38
Red fox (*Vulpes vulpes*)	8–10
Wild cat (*Felis silvestris*)	3–8
Small, fast-moving	
Cape hare (*Lepus capensis*)	1.3–7.0
Rock partridge (*Alectoris graeca*)	0.51–0.68
Fish (*Pices*)	
Small, slow-moving	
Tortoise (*Testudo* sp.)	1–2+

Results

Material input rates for fauna (NISP/L) and lithics (flakes and tools/L) are presented in Table 3.2 and Figure 3.4. In general, the density of lithics and faunal remains track one another fairly well, with layers IV and VIII having the highest density of the two artifact classes. Layer X has a spike in lithic materials but not fauna, so it is possible that attritional processes that affected bones were at play in this layer. Interestingly, the density of archaeobotanical remains somewhat differs from the faunal and lithic inputs, but it must be taken into account that the find densities of the seed remains are based on a much smaller sediment volume than lithics and bones. Seed density is by far the highest in layers IV and V, followed by III and VI and a few small spikes at the base of the sequence (Table 3.5, Fig. 3.5). There is no straightforward relationship between the density of faunal and lithic finds and the kind of screening conducted in each layer; two of the highest-density layers were wet-screened, while other wet-sieved layers have exceptionally low artifact densities.

Fauna

Total NISP counts by layer are found in Table 3.3. Ungulates are the most commonly identified group, followed by fish. At this point, we have identified no diagnostic fish elements; most bones are small vertebrae with a centrum diameter between 0.1 cm and 0.6 cm. The most common species-specific identifications are sheep/goat (*Ovis* and *Capra* sp.), gazelle (*Gazella gazella*), and tortoise (*Testudo* sp.). Other identified ungulates include pig (*Sus scrofa*), red deer (*Cervus elaphus*), and cattle (*Bos* sp.). It is unclear from the current sample if any of the ungulates were domesticated. Small numbers of turtle, hedgehog (*Erinaceus europaeus*), red fox (*Vulpes vulpes*), and Eurasian lynx (*Lynx lynx*) were also recorded. Species-specific designations for birds are not yet available. A claw of a crustacean was recovered from horizon I.

Bone mass and NISP counts for different prey groups are presented in Table 3.6 and Figure 3.6. Layers with extremely small NISP counts (<50) are excluded from the figure. It is clear that large game, in particular medium ungulates such as sheep and goat, dominate the assemblage by mass throughout the sequence. There is a spike in small ungulates (*i.e*. gazelles) in horizons VI and V, which is interesting given some changes in the botanical component of the site during these phases (see below). Very large ungulates (*i.e*. cattle) increase in importance as of horizon II. There are no temporal trends in faunal use in terms of broad prey categories (large versus small). Cochran's test of linear trend, a chi-square based statistic that is less susceptible to Type I and Type II statistical errors than other tests, and that is sensitive to small sample sizes (Cannon 2001), supports this. There is no significant temporal trend in the proportion of small to large game by mass through the sequence (x_{trend}^2=1.45, p=0.229). There is, however, a statistically significant trend in the increase of cattle in later phases of the sequence (x_{trend}^2=130.21, p<0.001).

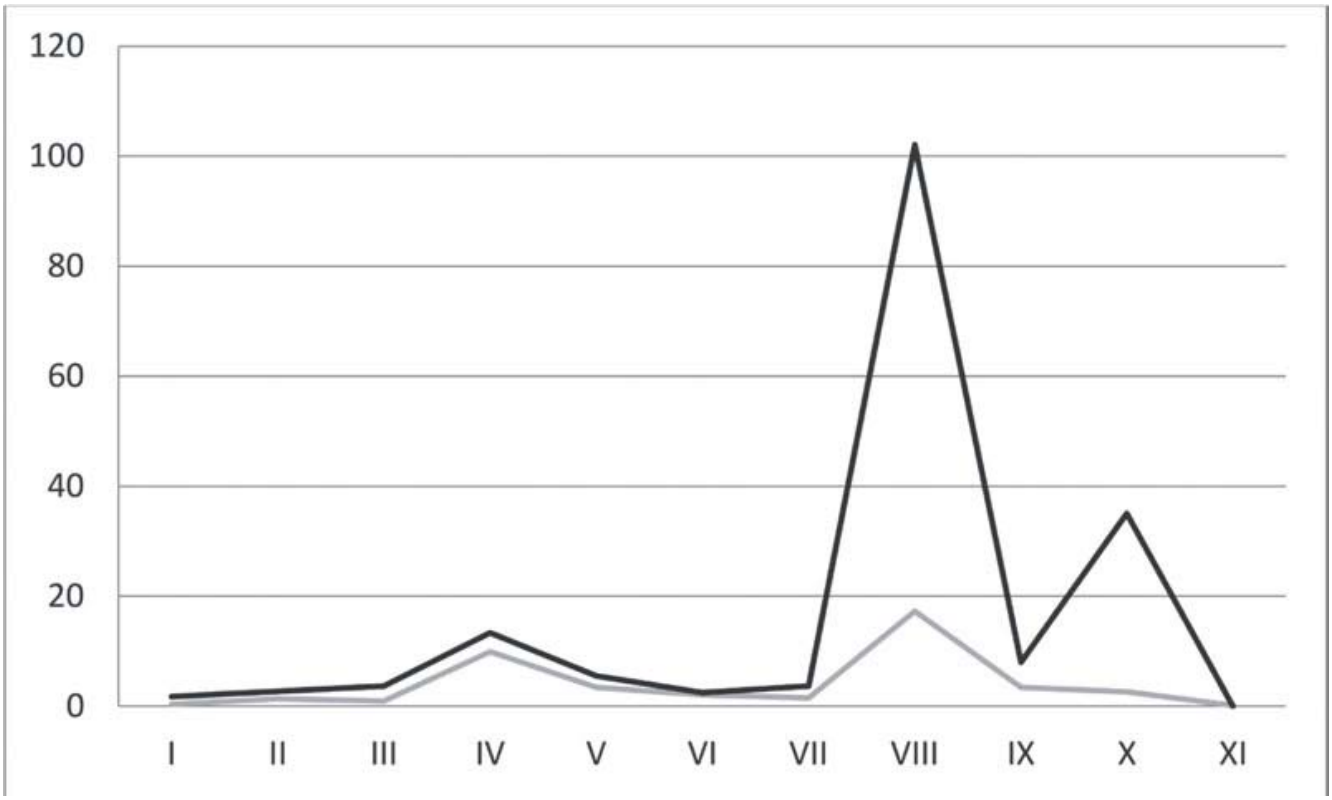

Fig. 3.4. Chogha Golan. Faunal (grey) and lithic (black) density (NISP/L sediments and lithic count/L sediments). Layers IV, V, VIII, X, and XI had 100% wet screening, the others did not. Data from Table 3.2.

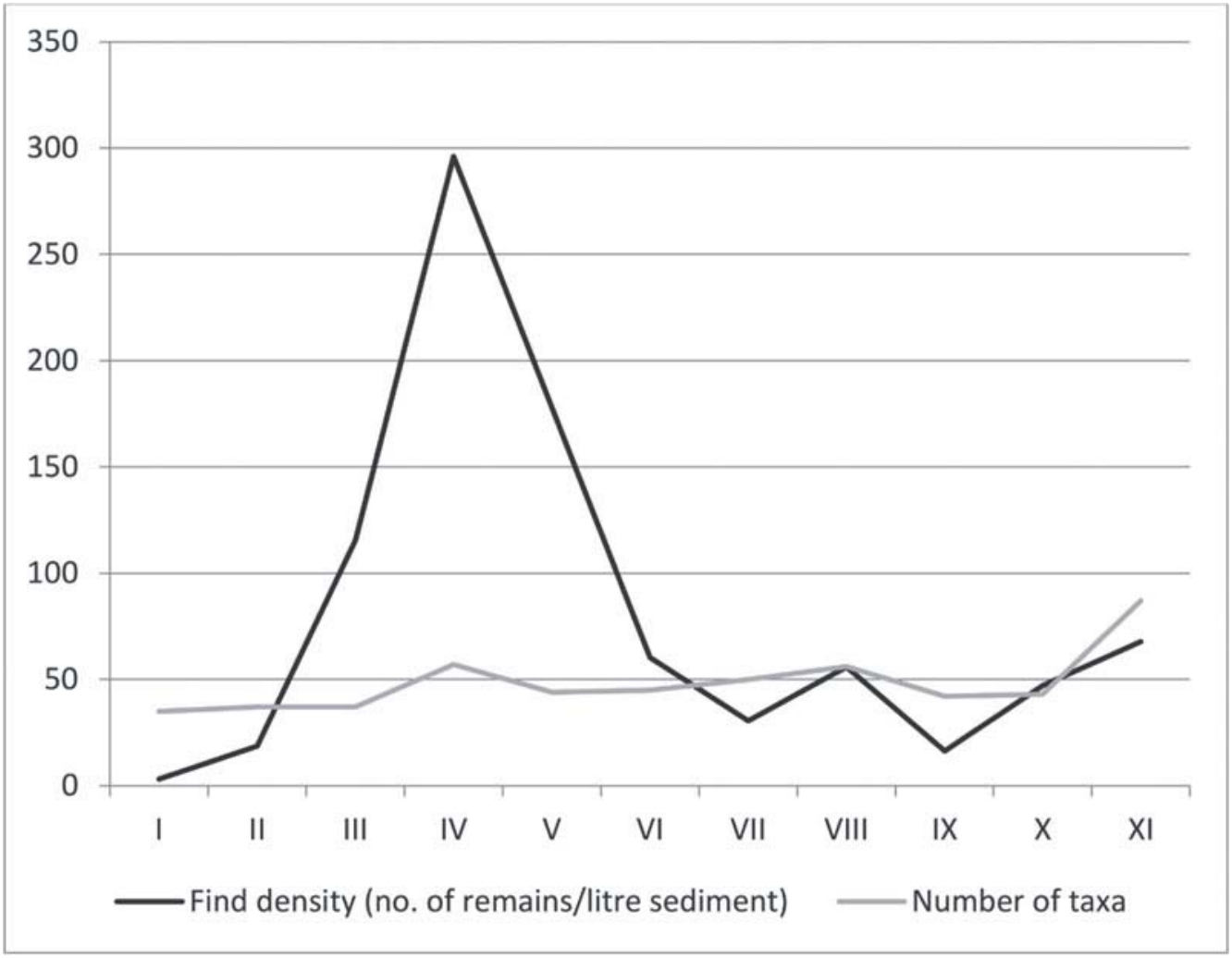

Fig. 3.5. Chogha Golan. Mean botanical find densities (no. remains/L sediment) and numbers of taxa for the different archaeological layers. Data from Table 3.5.

Table 3.5. Chogha Golan. Density of botanical remains from samples taken from the deep sounding.

AH	*Sediment volume (L)*	*No. samples*	*Sum*	*Botanical remains per L*
I	104	14	327	3
II	55	5	1025	19
III	20	2	2309	115
IV	30	3	8883	296
V	37	4	6585	178
VI	27	3	1629	60
VII	43	5	1310	30
VIII	28	3	1565	56
IX	38	4	624	16
X	20	2	942	47
XI	98	9	6646	68

In the Levant, an increase in small game, and more specifically changes in the proportion of certain small game taxa, has been interpreted as resource stress and changes in site use shortly before the adoption of agriculture (Davis 1987: 152–154, 2005; Davis *et al*. 1988; Munro 1999, 2004a). In some cases, there is a shift from easy to procure small, slow-moving animals (*e.g*. tortoises) to more difficult to catch small, fast-moving game items (*e.g*. birds, partridges, and fish) (Munro 2004a; Stiner 2001, 2005; Stiner *et al*. 2000). NISP counts of the four most common kinds of small game at Chogha Golan are depicted in Figure 3.7. There is no apparent shift from slow to fast animals. Fish are common throughout the sequence, and there is no trend in the use of hares or tortoises. There is a statistically significant decrease in birds through the occupation (x_{trend}^2=29.02, p<0.001), though this might be an effect of sample size. The main observation about the small game component of the site is that the occupants of Chogha Golan utilized locally available terrestrial and aquatic ecosystems, procuring mammals, birds, reptiles, and fish.

Frequencies of burning damage are presented in Table 3.7. Burn stages follow Stiner *et al*. (1995), and reflect color changes that correspond with exposure to increasingly high fire temperatures (unburned, carbonized or blackened, calcined or whitened). The majority of bones in all horizons are unburned. Frequencies of burning closely track whether or not sediments were wet screened. Horizons with the lowest incidences of burning (I and VI) had little or no wet screening, while those with the highest frequencies of burning (IV, VIII, Xb, and XI) were completely wet screened. This is not surprising as burning often increases the rate of fragmentation (Stiner *et al*. 1995), so burned specimens are more likely to be small and only recovered during wet screening.

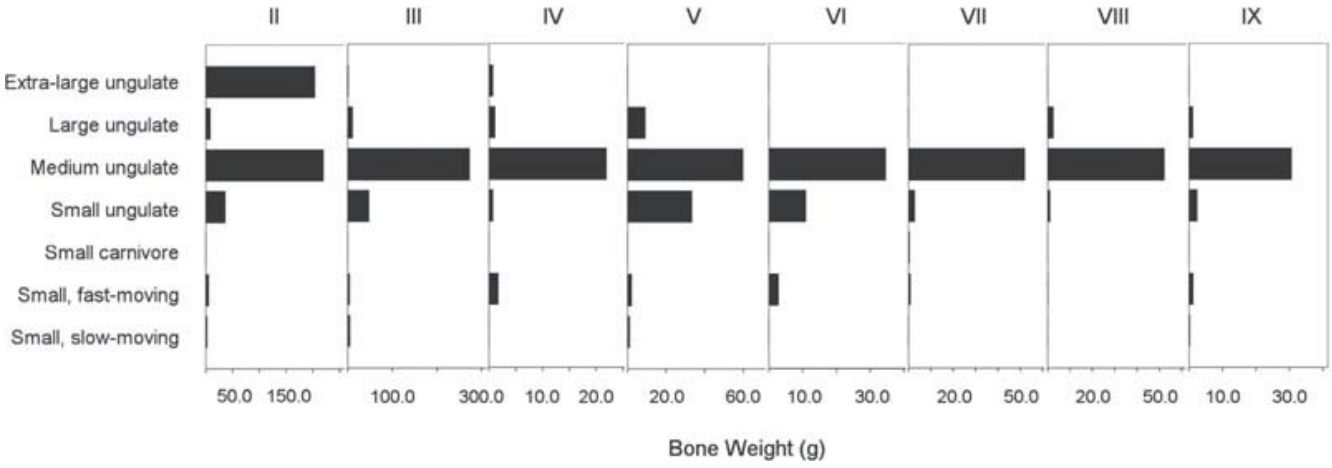

Fig. 3.6. Chogha Golan. Prey groups by bone weight. Layers with small sample sizes (NISP <50) are excluded from the figure. Medium ungulates are the most common for most of the sequence. There is a spike in small ungulate hunting in horizons V and VII. Extra-large ungulates increase significantly in horizon II. Data from Table 3.6.

Table 3.6. Chogha Golan. Distribution of NISP counts and weight of prey groups by layer.

	I				*II*				*III*				*IV*			
Size Class	*NISP*	*%*	*Mass (g)*	*%*	*NISP*	*%*	*Mass (g)*	*%*	*NISP*	*%*	*Mass (g)*	*%*	*NISP*	*%*	*Mass (g)*	*%*
Small, fast	1	5.3	0.0	0.0	76	51.7	5.1	1.1	50	28.6	4.2	1.3	96	76.8	1.7	6.5
Small, slow	0	0.0	0.0	0.0	7	4.8	2.1	0.4	4	2.3	4.8	1.4	1	0.8	0.0	0.0
Small ungulate	0	0.0	0.0	0.0	6	4.1	36.1	7.6	11	6.3	47.5	13.9	3	2.4	0.7	2.7
Medium ungulate	17	89.5	28.1	70.6	53	36.1	219.3	46.2	101	57.7	272.9	79.9	22	17.6	21.9	83.9
Large ungulate	0	0.0	0.0	0.0	2	1.4	8.2	1.7	7	4.0	10.7	3.1	2	1.6	1.1	4.2
Extra-large ungulate	1	5.3	11.7	29.4	2	1.4	203.4	42.9	1	0.6	1.4	0.4	1	0.8	0.7	2.7
Small carnivore	0	0.0	0.0	0.0	1	0.7	0.3	0.1	1	0.6	0.2	0.1	0	0.0	0.0	0.0
Total	19	100.0	39.8	100.0	147	100.0	474.5	100.0	175	100.0	341.7	100.0	125	100.0	26.1	100.0

	V				*VI*				*VII*				*VIII*			
Size Class	*NISP*	*%*	*Mass (g)*	*%*	*NISP*	*%*	*Mass (g)*	*%*	*NISP*	*%*	*Mass (g)*	*%*	*NISP*	*%*	*Mass (g)*	*%*
Small, fast	112	56.9	2.0	1.9	3	5.9	2.8	5.8	10	10.9	0.8	1.4	17	31.5	0.1	0.2
Small, slow	5	2.5	1.0	1.0	0	0.0	0.0	0.0	1	1.1	0.0	0.0	0	0.0	0.0	0.0
Small ungulate	15	7.6	33.3	31.7	2	3.9	10.9	22.6	2	2.2	2.7	4.8	4	7.4	1.0	1.8
Medium ungulate	57	28.9	59.8	56.8	46	90.2	34.6	71.6	77	83.7	52.0	93.0	31	57.4	52.2	93.5
Large ungulate	8	4.1	9.1	8.7	0	0.0	0.0	0.0	1	1.1	0.0	0.0	2	3.7	2.5	4.5
Extra-large ungulate	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Small carnivore	0	0.0	0.0	0.0	0	0.0	0.0	0.0	1	1.1	0.4	0.7	0	0.0	0.0	0.0
Total	197	100.0	105.2	100.0	51	100.0	48.3	100.0	92	100.0	55.9	100.0	54	100.0	55.8	100.0

	IX				Xb				XI				Total			
Size Class	NISP	%	Mass (g)	%	NISP	%	Mass (g)	%	NISP	%	Mass (g)	%	NISP	%	Mass (g)	%
Small, fast	26	38.2	1.2	3.4	1	3.1	0.4	1.8	1	10.0	0.0	0.0	393	40.5	18.3	1.8
Small, slow	3	4.4	0.2	0.6	4	12.5	2.3	10.4	0	0.0	0.0	0.0	25	2.6	10.4	1.0
Small ungulate	5	7.4	2.4	6.8	6	18.8	8.8	39.8	0	0.0	0.0	0.0	54	5.6	143.4	13.9
Medium ungulate	33	48.5	30.6	86.2	19	59.4	8.1	36.7	8	80.0	42.0	100.0	464	47.8	821.5	79.7
Large ungulate	1	1.5	1.1	3.1	0	0.0	0.0	0.0	0	0.0	0.0	0.0	23	2.4	32.7	3.2
Extra-large ungulate	0	0.0	0.0	0.0	2	6.3	2.5	11.3	1	10.0	0.0	0.0	8	0.8	3.2	0.3
Small carnivore	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	3	0.3	0.9	0.1
Total	68	100.0	35.5	100.0	32	100.0	22.1	100.0	10	100.0	42.0	100.0	970	100.0	1030.4	100.0

Evidence for butchery damage appears in Table 3.8. This sample excludes specimens only identified to the level of "mammal" or "bird" longbone or flatbone, so the smallest unidentifiable fragments do not overwhelm the data. Splits and spiral fractures are the most common classes of damage, followed by transverse fractures. Both kinds of fractures tend to result from marrow extraction. Cut mark frequencies and impact damage are fairly low, but all elements are included in Table 3.8, so it is possible that cuts on limb bones associated with dismemberment are underrepresented. Further analyses of these data will be conducted as the sample expands. We recorded four pieces of debitage from bone working. This supplements the small number of bone tools already recovered during the excavation.

Overall, frequencies of weathering and animal modifications are low (Table 3.9, this draws from the same sample used in the butchery analysis). Gnawing by rodents is much more common than carnivore gnawing, which might suggest that domesticated dogs were either not kept, or did not have access to this portion of the site. Of course, caution must be exercised with this interpretation given the limited scope of the sample. The pattern of weathering damage is interesting. In general, weathering is uncommon, which might indicate fast deposition of sediments and rapid burial of bones. We observed chemical weathering on bone surfaces, but only on remains from the top two archaeological horizons (I and II). This correlates with observations on the archaeobotanical remains, which are reduced in numbers and generally corroded in the surface layers (Fig. 3.5). These patterns of weathering might reflect some kind of mechanical, post-depositional activity in the upper layers.

Flora

To date we have identified 117 botanical taxa, and this number is likely to increase with ongoing research at the site. The most numerous taxa belong to the Poaceae and Fabaceae families, mostly represented by wild barley (*Hordeum spontaneum*), goat grass (*Aegilops* sp.) and small-seeded pulses. The range of wild progenitors of the founder crops also includes wheat species (*Triticum boeoticum*, *T. dicoccoides*, Triticoid types), lentil (*Lens* spp.), and grass pea (*Lathyrus* spp.). In the two uppermost layers glume bases of morphologically domesticated-type emmer are present, which we interpret as the beginnings of wheat domestication (Riehl *et al*. 2013).

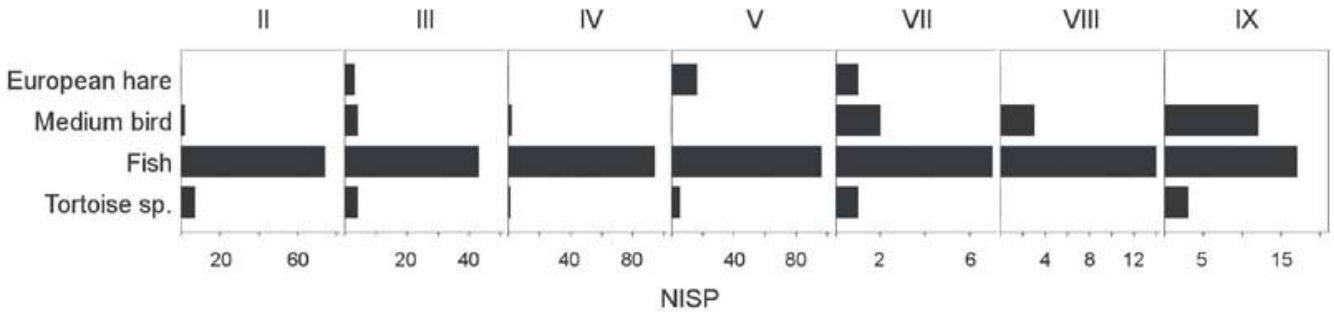

Fig. 3.7. Chogha Golan. Representation of small game by NISP count. Fish are the most common taxa in all layers. Medium birds decrease in frequency after layer VII. Layers with small samples are again excluded. Data from Table 3.3.

Table 3.7. Chogha Golan. Burning frequencies by layer. Note, this sample includes all fragments, even those only identified as small or medium mammal. Burn stages follow those set forth in Stiner et al. *(1995).*

	I		*II*		*III*		*IV*		*V*		*VI*	
Burn stage	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*
unburned	327	87.2	825	79.4	832	80.9	544	72.3	801	81.2	113	86.9
<1/2 carbonised	18	4.8	45	4.3	44	4.3	40	5.3	32	3.2	0	0.0
>1/2 carbonised	8	2.1	60	5.8	61	5.9	55	7.3	32	3.2	6	4.6
fully carbonised	13	3.5	72	6.9	67	6.5	84	11.2	97	9.8	1	0.8
<1/2 calcined	7	1.9	26	2.5	20	1.9	15	2.0	20	2.0	8	6.2
>1/2 calcined	0	0.0	8	0.8	3	0.3	7	0.9	3	0.3	2	1.5
fully calcined	2	0.5	3	0.3	1	0.1	7	0.9	2	0.2	0	0.0
Total	375	100.0	1039	100.0	1028	100.0	752	100.0	987	100.0	130	100.0

	VII		*VIII*		*IX*		*Xb*		*XI*		*Total*	
Burn stage	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*
unburned	231	84.9	436	72.1	466	81.5	114	74.0	42	58.3	4731	79.0
<1/2 carbonised	8	2.9	33	5.5	16	2.8	11	7.1	6	8.3	253	4.2
>1/2 carbonised	10	3.7	52	8.6	34	5.9	12	7.8	12	16.7	342	5.7
fully carbonised	17	6.3	66	10.9	49	8.6	9	5.8	11	15.3	486	8.1
<1/2 calcined	4	1.5	14	2.3	4	0.7	5	3.2	1	1.4	124	2.1
>1/2 calcined	2	0.7	4	0.7	2	0.3	2	1.3	0	0.0	33	0.6
fully calcined	0	0.0	0	0.0	1	0.2	1	0.6	0	0.0	17	0.3
Total	272	100.0	605	100.0	572	100.0	154	100.0	72	100.0	5986	100.0

As mentioned above, seed density is highest in layers IV and V. The difference in seed density between these two and the other layers is also reflected in the different taxa groups. While wild barley and other large-seeded grasses, including goat grass, reach particularly high proportions in the lower part of the stratigraphic sequence, they strongly decrease in layers V and IV (Fig. 3.8).

Frequencies of small-seeded grasses drastically increase in layer V and remain high until layer III, contrasting with a decrease in the wild progenitor species of modern crops (including wild barley, Triticum-type species, lentil and other large-seeded pulses). There is a change from horizon III onwards, when Triticum-type species and goat grass again increase. In horizon II, chaff from domesticated-type emmer appears.

Table 3.8. Chogha Golan. Butchery damage by layer. Cone fractures and cut marks are rare, but present. Most damage is from breakage for marrow extraction. The sample does not include the general categories small or medium mammal.

	I		*II*		*III*		*IV*		*V*		*VI*	
Butchery damage	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*
Cone/Impact fracture	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0
Transverse fracture	0	0.0	5	2.7	8	3.7	1	0.7	4	1.6	0	0.0
Split/Spiral fracture	1	3.4	12	6.4	20	9.2	9	6.1	13	5.3	0	0.0
Cut marks	0	0.0	5	2.7	12	5.5	1	0.7	3	1.2	2	3.5
Worked	0	0.0	0	0.0	1	0.5	1	0.7	1	0.4	0	0.0
Total	29		188		217		147		247		57	

	VII		*VIII*		*IX*		*Xb*		*XI*		*Total*	
Butchery damage	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*
Cone/Impact fracture	0	0.0	1	0.7	0	0.0	0	0.0	0	0.0	2	0.1
Transverse fracture	1	0.9	2	1.5	6	4.4	3	4.9	0	0.0	30	2.2
Split/Spiral fracture	5	4.5	10	7.5	12	8.9	10	16.4	3	30.0	95	7.1
Cut marks	1	0.9	1	0.7	3	2.2	4	6.6	0	0.0	32	2.4
Worked	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0	4	0.3
Total	111		134		135		61		10		1336	

Assuming that the assemblage is representative of subsistence development at the site, the changes suggest a shift in resource availability, specifically the reduction in large-seeded grasses during phases IV and V.

Discussion and conclusion

At this point in the analysis, we must be cautious with drawing broad conclusions about Chogha Golan in general, and its implications for understanding wider trends in the Zagros during the aceramic Neolithic. It is similarly difficult to place the site within an historical context because robust floral and faunal data from the region are fairly sparse, and tend to focus more specifically on the question of domestication (*e.g*. Zeder 1999, 2008a; Zeder and Hesse 2000). However, a few points of comparison are available. At Yafteh Cave, an Upper Paleolithic site in the Central Zagros, most faunal remains are from sheep and goat, followed by gazelles (Otte *et al*. 2007). In addition, analysts identified hundreds of fish bones at the site, particularly in three of the four uppermost layers. The excavators note that the

fish could have been accumulated by non-human carnivores, though they do not exclude the possibility of human fishing (Otte *et al*. 2007). Hesse (1989) presents an extremely small sample of faunal remains (NISP=56) from later Paleolithic layers at Gahr-I-Khar. He notes that while most of the remains are from ungulates, sheep and goat in particular, there are also a few bones from birds and small mammals such as martens. Munro (2004b, 2009) examines trends in small game use from the Epipaleolithic through Ceramic Neolithic at several sites in the Zagros region. She finds that the percentage of small game is high during the Epipaleolithic, compared to the subsequent Aceramic and Pottery Neolithic phases at the sites. Munro (2004b, 2009) interprets this as the replacement of difficult-to-procure small game species by domesticated ungulates. These few case studies provide the bulk of the comparative local data, though the situation will likely improve as more excavations occur in the region.

Table 3.9. Chogha Golan. Weathering and animal damage by layer. Note that there is more chemical weathering in layers closer to the surface. The sample does not include the general categories small or medium mammal.

	I		*II*		*III*		*IV*		*V*		*VI*	
Gnawing damage	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*
Rodent gnawing	1	3.4	5	2.7	4	1.8	2	1.4	2	0.8	0	0.0
Bites	0	0.0	1	0.5	3	1.4	1	0.7	0	0.0	0	0.0
Punctures	0	0.0	1	0.5	0	0.0	2	1.4	0	0.0	0	0.0
Digestion	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Weathering												
Some surface exfoliation	0	0.0	0	0.0	1	0.5	0	0.0	2	0.8	0	0.0
Chemical weathering	9	31.0	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0
Root etching	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0
Total	29		188		217		147		247		57	

	VII		*VIII*		*IX*		*Xb*		*XI*		*Total*	
Gnawing damage	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*	*NISP*	*%*
Rodent gnawing	5	4.5	1	0.7	4	3.0	0	0.0	0	0.0	24	1.8
Bites	2	1.8	0	0.0	1	0.7	0	0.0	0	0.0	8	0.6
Punctures	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.2
Digestion	0	0.0	0	0.0	1	0.7	0	0.0	0	0.0	1	0.1
Weathering												
Some surface exfoliation	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.2
Chemical weathering	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	11	0.8
Root etching	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1
Total	111		134		135		61		10		1336	

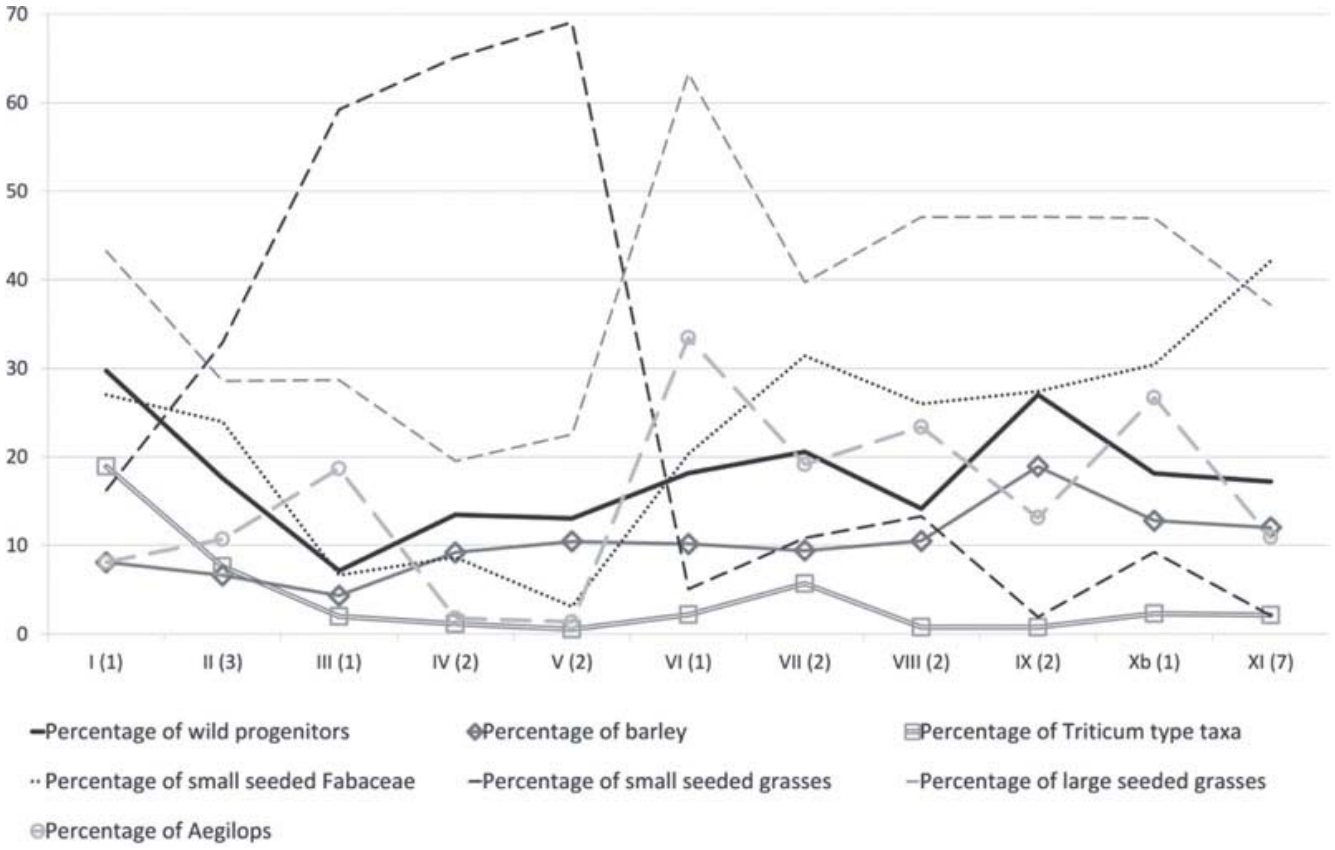

Fig. 3.8. Chogha Golan. Percentage proportions of taxa and taxa groups relevant to plant subsistence for the different archaeological layers. In brackets the number of samples used for the calculation.

At the most basic level, in terms of both the floral and faunal components of Chogha Golan, we can say that humans were largely exploiting taxa that were later domesticated in southwest Asia, which is similar to the studies mentioned above. The exception to this are many of the small seeded grasses (particularly *Phalaris* sp. and *Eragrostis* sp.), gazelles, and the non-mammalian fauna. This corresponds to patterns seen elsewhere in the Zagros (Savard *et al*. 2006; Zeder 1999, 2008a), and is not surprising considering the natural ranges of many domesticates.

Several trends in subsistence have already emerged at Chogha Golan, and are apparent in both the botanical and faunal remains. The first is a shift that occurs during archaeological horizons VI and V. There is a spike in the exploitation of small-seeded grasses, along with an increase in gazelle hunting. This might be the temporary result of resource stress, driven by environmental change. A possible scenario is that an increase in aridity led to a depletion of large-seeded grasses, and humans responded by intensifying their use of small-seeded grasses and small-bodied ungulates. Ongoing charcoal analyses by Dr Eleni Asouti (University of Liverpool) will help resolve the climatic situation at the site to further test this hypothesis. In any case, the meat diet subsequently rebounded back to mostly medium-sized ungulates, while small-seeded grasses continued to be important until horizon III.

Another major change in subsistence is the presence of domesticated-type emmer wheat in layer II, which appears alongside the increased importance of cattle-sized animals. The faunal results in particular from this layer represent an extremely small sample, and further excavations are necessary to provide data on animal domestication at the site, but layer II could represent a more dedicated shift to domesticated resources in general. This is also supported by a slight increase in sickle blades and groundstone implements in horizons II and I (Conard and Zeidi 2013). The small game component of

the site was relatively unimportant in terms of overall contribution of meat to the diet, but it does indicate that the occupants of Chogha Golan utilized a wide range of available ecosystems. Though frequencies of bird hunting drop after horizon VII, fishing was a constant at the site.

The situation in the Levant has important similarities and differences with what we have currently found at Chogha Golan, and is a logical point of comparison because of its proximity and number of well-studied sites. There is evidence in the Levant of sedentism and complexity before the dawn of agriculture (Perrot 1960, 1966), which is also the case at Chogha Golan. However, in the Levantine Natufian during the terminal Pleistocene, there was a considerable amount of resource intensification, evidenced by the hunting of low-ranked small game, juvenile animals (particularly gazelles), and increased carcass processing (Bar-Oz and Munro 2005; Davis 1987, 2005; Davis *et al*. 1988; Munro 2004a, 2004b; Stiner *et al*. 2000). Based on the current sample from Chogha Golan, it is premature to fully reject a similar situation in the Zagros. However, the evidence presented here does not track an intensification trend; rather there are nuanced changes that might correlate more closely with environmental shifts and the eventual adoption of domesticates.

This preliminary analysis of the faunas from Chogha Golan, along with the more advanced stage of analysis of archaeobotanical remains, is a step toward more fully understanding the use of wild resources and eventual domestication in the Zagros region. A major strength of the project is that Chogha Golan was excavated using modern recovery and analytical techniques. This allows for the marrying of floral and faunal data at the site, which was often not possible in the past. Therefore, we are well-positioned to understand the full dietary spectrum of the site's occupants. Further analysis of both the faunas and the archaeobotanical materials, along with environmental reconstructions of the area, and future excavations of the site, will continue to provide a comprehensive, updated picture of the Zagros region during the aceramic Neolithic. Unsurprisingly, the origins of food production are more complicated than was previously recognized, and the process had a strong regional signal. It also makes clear that in some areas sedentary village life was not unprecedented, even before the appearance of domesticated resources.

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Chapter 4

Adoption, Intensification and Manipulation of Sheep Husbandry at Tell Halula, Syria during the Middle to Late PPNB

C. Tornero, M. Molist and M. Saña

Sheep were adopted at the PPNB settlement of Tell Halula, Syria by ~7,500 cal BC. During earlier occupations, sheep were completely absent with meat production based on other domestic species. However, after their adoption, artificial breeding of sheep became one of the primary productive animal exploitation strategies within a short time span, (~7,000 cal BC) when production was diversified. Recent research has enlarged the available sample of sheep remains associated with archaeological phases spanning the sheep adoption process at Tell Halula. This study integrates osteological and osteometrical analyses to evaluate how the importance of sheep husbandry increased and was consolidated during the first steps of its adoption. Body-size, herd structure and traits indicating production strategies are evaluated and demographic profiles were reconstructed from reliable mortality profiles and sex-ratio distributions. The data show that upon adoption, herds were not only managed to ensure a supply of meat, but the control of reproduction and the formation of larger herds also had an important role. Slaughter patterns reveal an interest in maintaining mature and reproductive age animals during the first stages of the process and suggest an increased prevalence of females. A highly significant fact is the evidence that the required flow of animals to conform long-term reproductive herds were conformed by already domestic specimens (with reduced size) and not wild. Overall, the increase of sheep production over time illustrates the success achieved in this strategy, and that the adoption of already-domestic animals was one of the strategies used by the early herding communities during the PPNB.

Introduction

Early evidence for the presence of domestic sheep (*Ovis aries*) has been suggested in the Upper and Middle Euphrates Valley, Syria. The precise chronology and geography of the initial domestication of

the species is still unknown, but the first evidence dates from 8,500 cal BC during the Early Pre-Pottery Neolithic – B in Nevalı Çori (Peters *et al*. 2005). Osteometrical analyses, sex- ratio indices and taxonomic frequencies have frequently been the main criteria used to recognize sheep in their domestic form in zooarchaeological studies However, until ~7,500 cal BC, very few sites yield specimens that confidently allow us to identify domestic sheep. After ~7,500 cal BC the number of sites with domestic sheep remains increases considerably, and they are spread some distance from this area of initial domestication. The importance of this species in subsistence strategies during this period is highlighted by the significant increase in numbers during the Middle PPNB and Late PPNB in the Northern Levant. Although it is suggested that goats (*Capra hircus*) were the first domestic species (*i.e*. goats are dominant at the beginning of the sequence in many sites), sheep later become similarly represented or better at many sites (Helmer *et al*. 2007; Peters *et al*. 1999, 2013).

Tell Halula (Middle Euphrates Valley, Arab Republic of Syria) is a well-documented case study illustrating this process. Zooarchaeological analyses conducted at Tell Halula since the beginning of the 1990s allow us to recognize how domestic species were incorporated in the settlements economy. Previous research by Maria Saña (1999, 2001), recognized that; a) when the settlement was first occupied, domestic goats were already present but sheep were completely absent, and b) the presence of domestic sheep is not well attested to at least until Occupation Phase 8, corresponding to Late PPNB around 7,400 cal BC. Indeed, if we focus on the frequency of sheep during the PPNB Phases (1–22) at Tell Halula, we can see how sheep are absent in the early phases and then, how exploitation became similar to or much more important than for the previously phases where goats were dominant (Fig. 4.1).

Recently, from the PhD of Carlos Tornero, we enlarged the available sample from the archaeological phases dating to, and representing, the sheep adoption process (Tornero 2011). The new results dating to occupation phases 8–12 should aid more precise understandings of the adoption process and allow better description of the characteristics of the sheep population.

Objectives

The main objective of this study is to understand why the communities settled at Tell Halula decided to integrate sheep into their economic strategy. In order to do so, we characterize the sheep stock-keeping at Tell Halula, evaluating its intensity, record osteometric characteristics, establish mortality profiles and determine its sex distribution. We expect that these data will permit understand of how sheep were exploited and managed. This information will shed light on the reality of sheep adoption and management and evaluate the relative success and constraints of these strategies.

Materials and methods

Tell Halula (7,800–5,700 cal BC)

Tell Halula is an archaeological site located in the middle Euphrates Valley (Arab Republic of Syria). The site is located 800 m from the north (right) bank of the Euphrates. It was occupied between the eighth and sixth millennia BC covering a large area totaling around 9 ha. The site was excavated starting in 1990 until the present by a Spanish Archaeological Mission under the direction of Prof. Miquel Molist of the Autonomous University of Barcelona (Fig. 4.2).

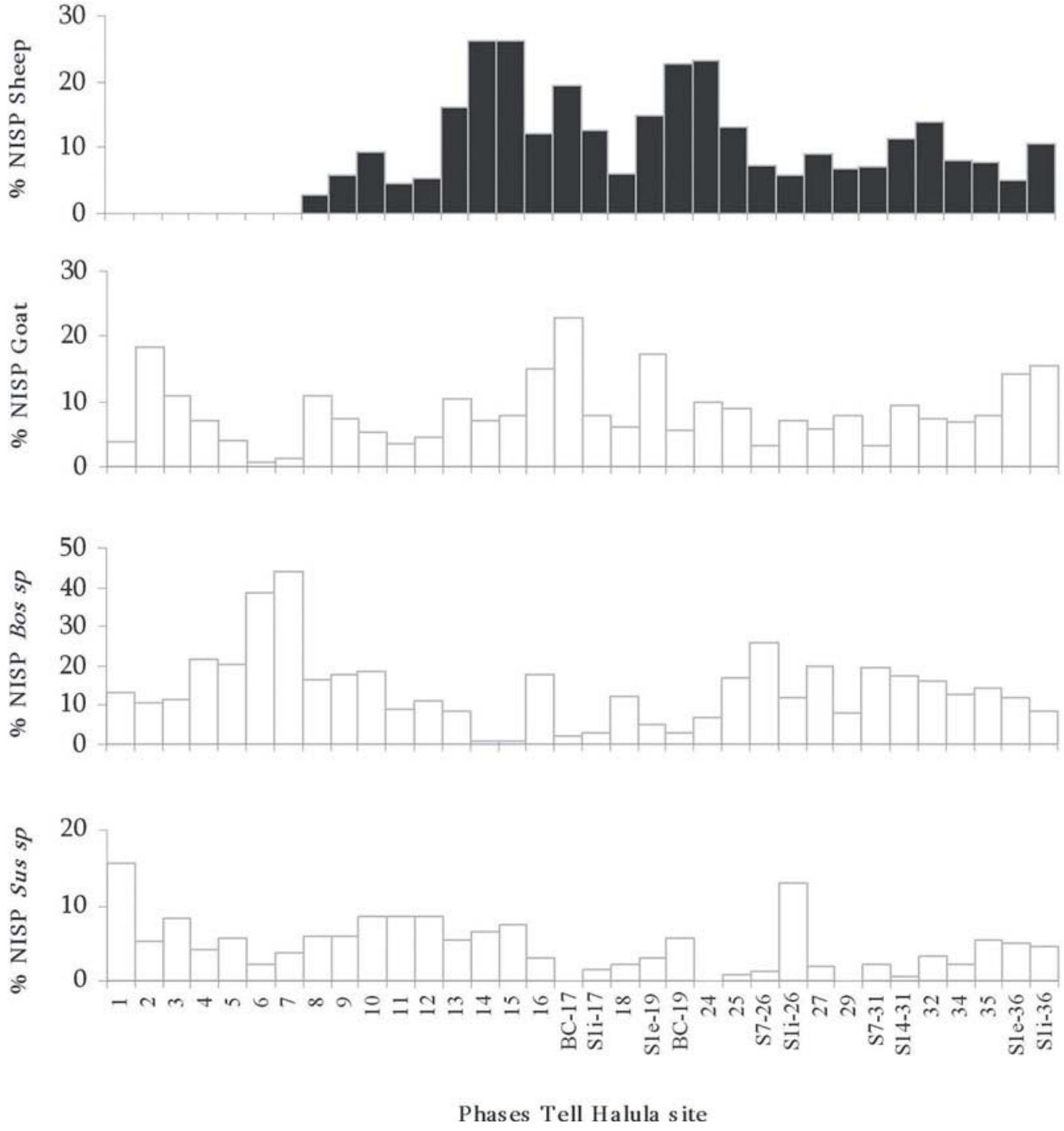

Fig. 4.1. NISP % of the main domestic species (sheep, goat, cattle and pig) throughout the sequence of occupation at Tell Halula (from Saña, 1999: table 24: 130). Phases PPNB *1–22; phases* Pre-Halaf *23–33; phase* Proto-Halaf *34 and phases* Halaf *35–37.*

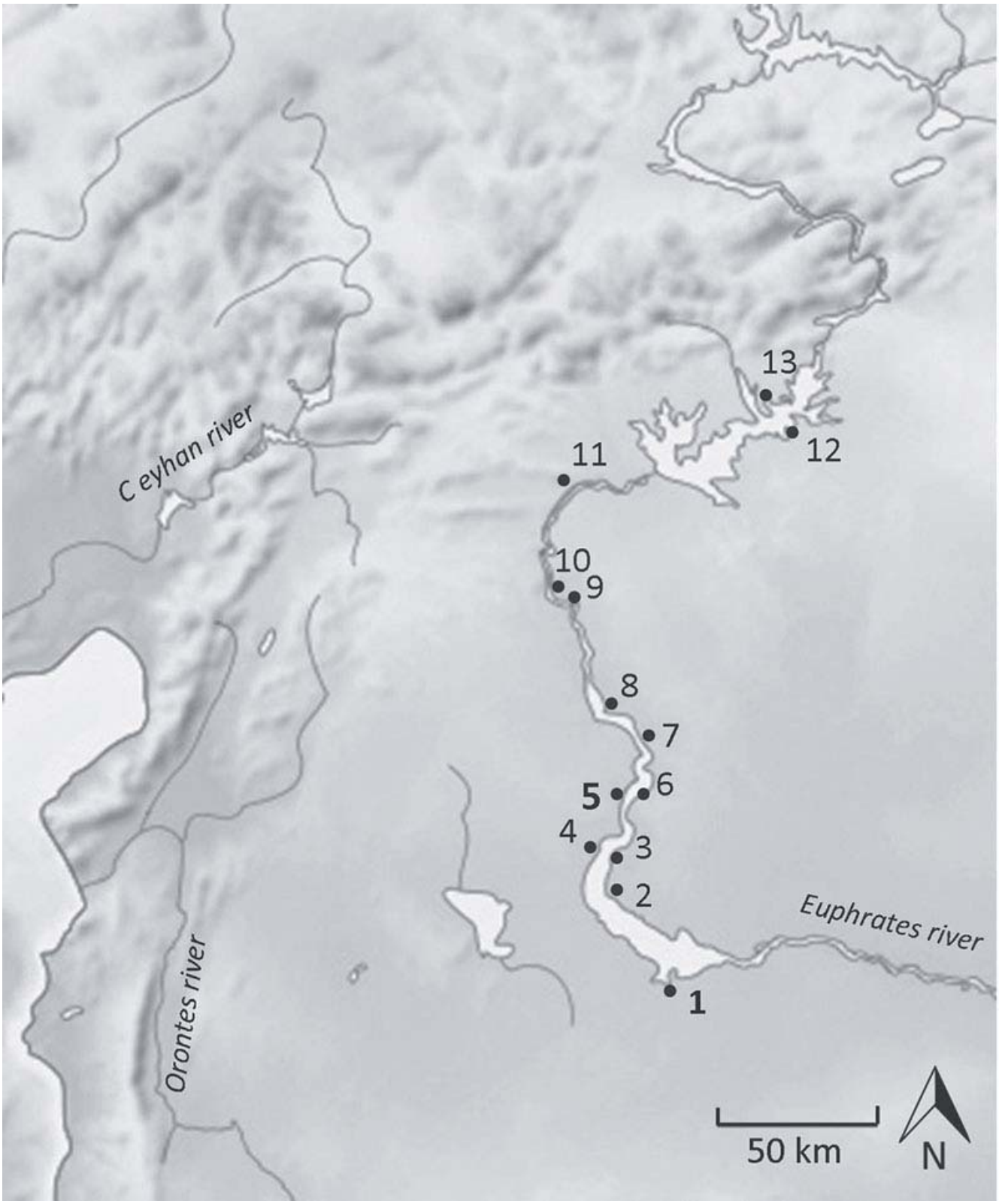

Fig. 4.2. Map of the main archaeological sites mentioned in the text: 1. Abu Hureyra; 2. Tell Mureybet; 3. Cheikh Hassan; 4. Narh el-Hom r; 5. Tell Halula; 6. Jerf el-Ahmar; 7. Dja'de el Mughara; 8. Tell 'Abr; 9. Akarçay tepe; 10. Mezraa Teleilat; 11. Hayaz Höyük; 12. Nevali Çori; 13. Gritille.

Archaeological excavation conducted at Tell Halula exposed 4,200 m^2 of a practically continuous occupation sequence from the Middle PPNB to the Late Halaf periods (Molist 1996, 2013). From the early levels, settlement occupation was sedentary. During the Middle and Late PPNB levels the

settlement was organized around dwelling units all with a similar layout. Most dwellings were pluri-cellular adobe houses, with a rectangular floor plan (Molist 1998; Molist *et al*. 2007; Saña and Molist 2004) (Fig. 4.3).

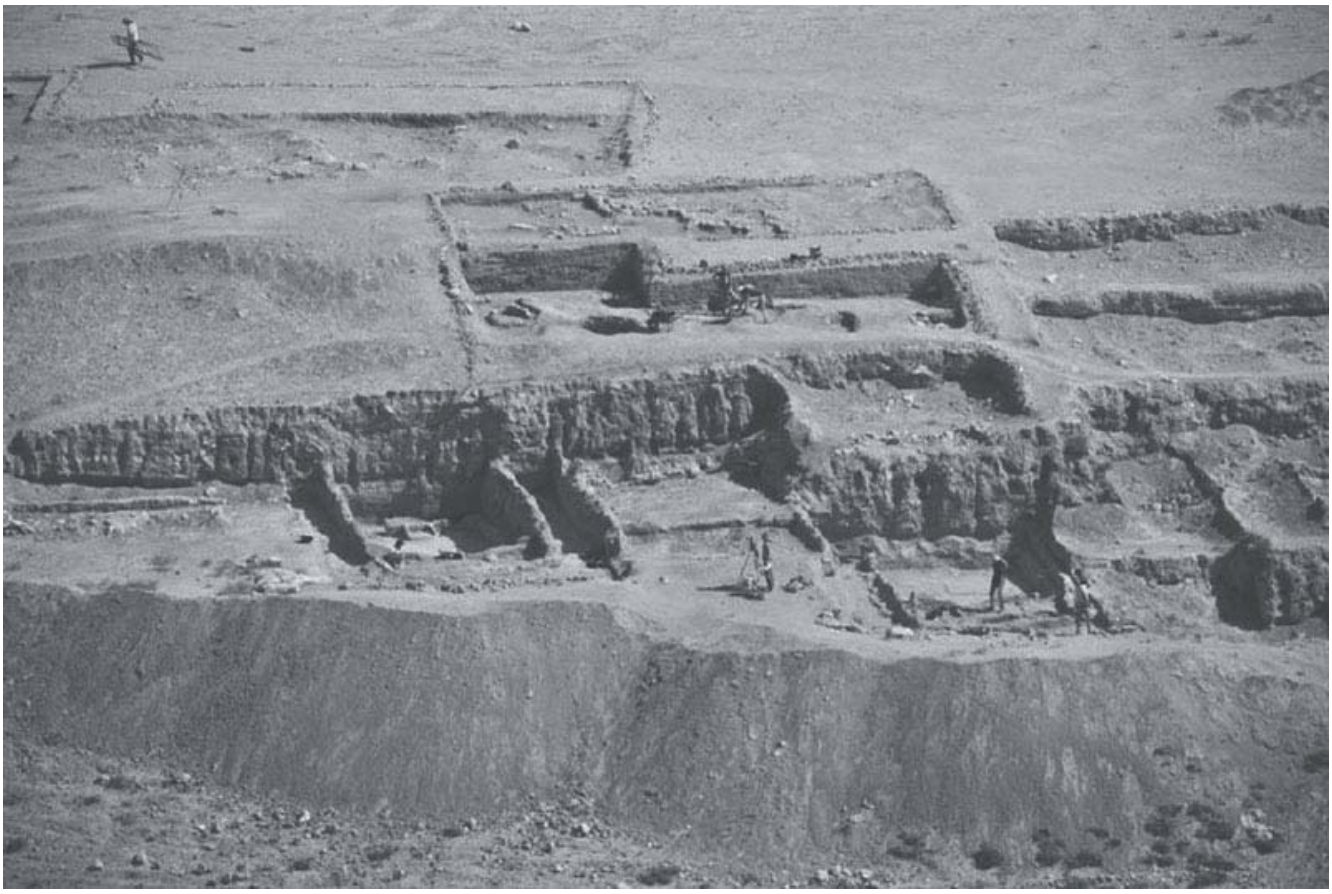

Fig. 4.3 (a). Tell Halula: Houses (dwellings) excavated in PPNB levels.

Fig. 4.3 (b). Tell Halula: south view of sector IV.

Subsistence strategies were mainly based on cereal agriculture and livestock management: domestic cereal production (naked wheat, barley and emmer) is broadly and well documented while animal husbandry was focused on cattle, goat, sheep and pig (Araus *et al*. 2014; Buxó and Rovira 2013; Saña 1999; Tornero 2011). However, there is evidence for the exploitation of wild resources as well. Charcoal studies indicate the exploitation of species from a wide range of ecosystems: from river valleys (*Tamarix*, *Salicaceae*, *Ulmus* and *Fraxinus*), oak forests (*Quercus* sp., *Pomoideae* and *Ficus carica*) and steppe (*Amygdalus*) (Willcox and Català 1996; Piqué and Mensua 2008). Zooarchaeozoological studies document the exploitation of wild species such as gazelle (*Gazella subgutturosa* sp.), onager (*Equus hemionus*), European/Persian fallow deer (*Dama dama* and *Dama mesopotamica*), roe and red deer (*Capreolus capreolus* and *Cervus elaphus*), boar (*Sus scrofa*), badger (*Meles meles*), red fox and Blanford's fox (*Vulpes vulpes* and *Vulpes cana*) and probably wolf (*Canis lupus*). Birds, freshwater molluscs (bivalves) and fish are also represented in low proportions.

Zooarchaeological analyses

Analyses of the faunal remains were carried out in Syria, at the excavation-lodging of the Spanish mission in Tell Halula and at the Laboratory of Archaeology of the National Museum of Damascus, between 2007 and 2009. Access to modern comparative skeletal material was limited in both cases. A basic anatomical collection of different elements and species (*i.e*. goat, sheep, gazelle, cattle and onager) was utilized in conjunction with in-print bone atlases for anatomical and taxonomic determinations (Barone 1976; Pales and Lambert 1971; Schmid 1972).

Distinction between sheep and goat remains was carried out utilizing Boessneck *et al*. (1964), Boessneck (1969), Payne (1973) and Prummel and Frisch (1986) for post-cranial elements. Teeth were identified following the criteria in Halstead and Collins (2002), Balasse and Ambrose (2005) for permanent dentition and Payne (1985) and Helmer, (2000b) for deciduous dentition.[1]

Age at death was estimated from mandibular teeth remains. We estimated age according to dental eruption based on Schmid (1972), Hillson (2005) and Milhaud and Nezit (1991), and dental wear stage based on Payne (1973) and Helmer (2000a). Tooth age profiles were built according to Vigne (1988) and Helmer and Vigne (2004). No normalization was applied to the raw data (Vigne and Helmer 2007). Data is expressed in terms of skeletal age and histograms represent age profiles. Sex has been also inferred from faunal remains. Some osteometrical criteria allowed sex-discrimination between specimens, related to sexual dimorphism. Mixture analyses and Kernel distribution analyses were used to test the statistical significance of the sample. Both age and sex information were used to reconstruct demographic profiles.

Osteometric measurements were taken according to von den Driesch (1976). A measure of the high of the trochlea (HTC) on the distal diaphisis of the humerus has been additional employed in this study. Only fused bones were measured. Log ratio/size indices were constructed for sheep using comparative modern data from a mouflon specimen reported in Uerpmann (1979). No taphonomic processes significantly altering frequencies of any age category have been observed (Tornero 2011).

Results

Approximately 20,000 bone fragments were analyzed from Occupation Phases 8–12. Of these, 43.1% were identified to taxon. Sheep represent 7.32% of the assemblage. The relative frequency of sheep is reported in Figure 4.4. The sheep data are compared to those obtained from the other domestic species already present at the site throughout these phases in order to obtain a more general view of the role of sheep in the economy. Once sheep are introduced, its relative frequency increases quickly, overtaking that of goat by the end of the Phase 12. Indeed, once sheep increases in frequency, not only do goat decrease, but also the number of remains identified to bovids and *suidae* decrease (in both cases samples are dominated by the domestic form – *Bos taurus* and *Sus domesticus* – but wild ancestors, in minor number, cannot be ignored). This increase in sheep NISP throughout Phases 8–12 is also documented by the minimal number of individuals (MNI) and by the minimal number of elements (MNE) (MNI Phase 8=21; Phase 9=21; Phase 10=18; Phase 11=29; Phase 12=36; MNE Phase 8=59; Phase 9=88; Phase 10=54; Phase 11=119; Phase 12=202).[2]

Osteometric measurements have been used to characterize size of the earliest adopted sheep specimens from Tell Halula. Measures of the humerus and astragalus are plotted in Figure 4.5. In the humerus, the distribution of BT and Bd (von den Driesch 1976) are lower when compared with available wild mouflon specimens (from Natufian to PPNA levels of Tell Mureybet, just 100 km away in the south). However, when similar data from the Halula sheep are compared with the available data from PPNB late and PN levels of surrounding sites, the values indicate similarities to those associated with domestic populations. High intra-site variability is nevertheless observed at Tell Halula.

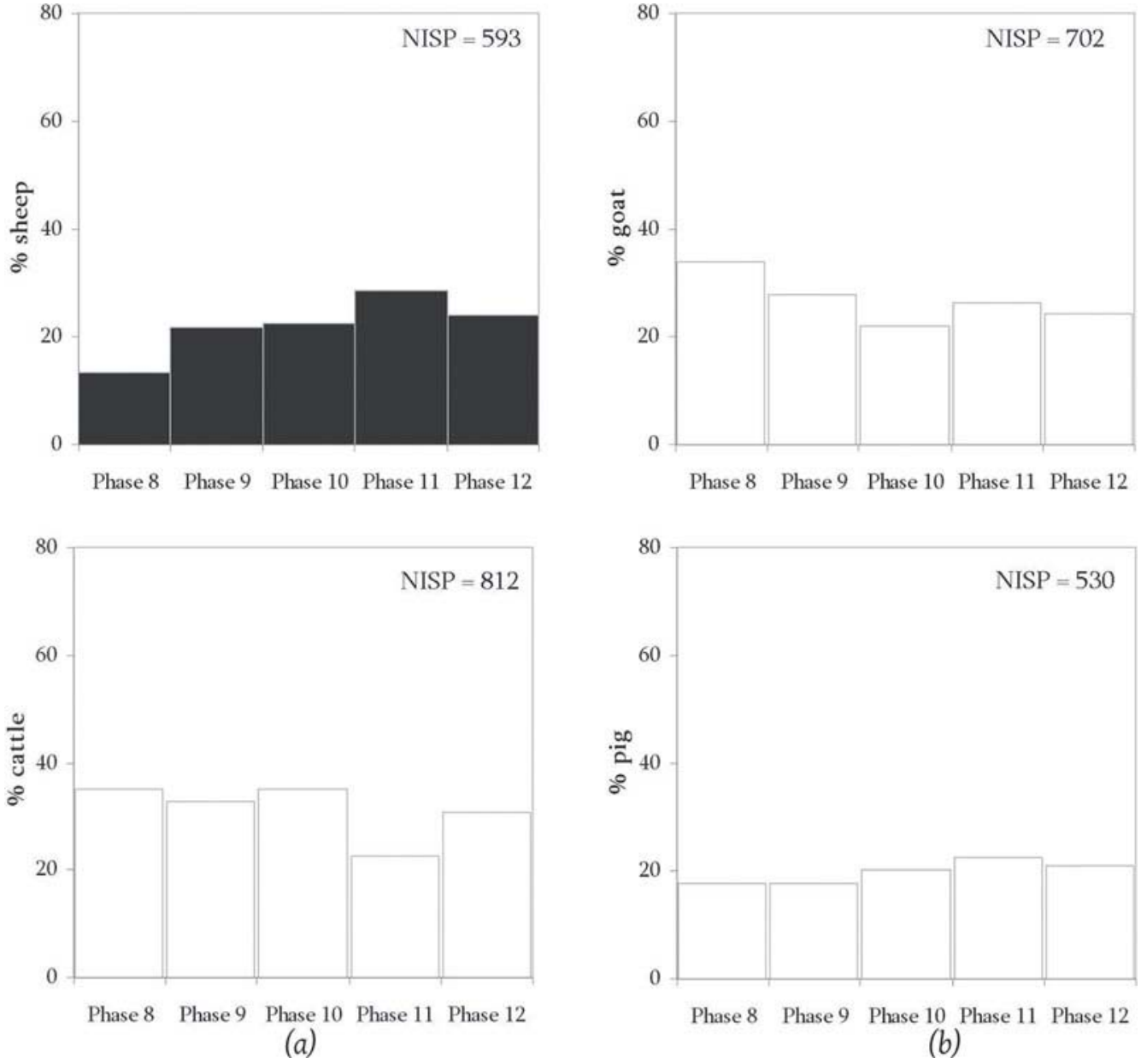

Fig. 4.4. NISP % of the main domestic categories (sheep, goat, cattle and pig) throughout Phases 8–12 of Tell Halula. Goat, cattle and pig data belongs from Tornero (2011).

The same type of comparison was utilized with Bd and GLI measurements of the astragalus. The Tell Halula data are clearly different from the wild mouflon data, although there is some overlap. When sheep data from more recent levels are considered, our data show a slightly larger size than the domestic reference material. Figure 4.6 (a and b) summarize these observations, and compare the sheep population from Tell Halula with the wild mouflon population and samples of domestic sheep from later PPNB sites and PN sites. Briefly, the sheep population introduced at Tell Halula fits well with domestic population size characteristics. These data shows that sheep adopted at Tell Halula were similar in size to domestic populations in the study area. These data suggest that domestic sheep populations can be identified by markedly reduced size. No larger-sized wild specimens seem to have been introduced.

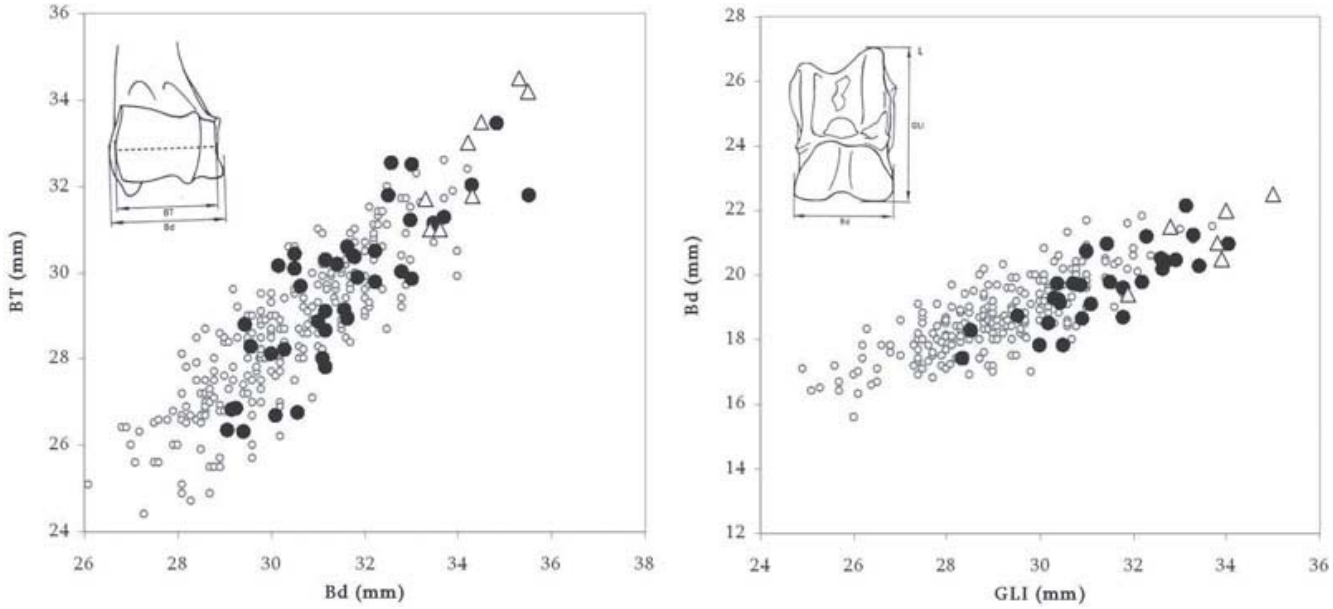

Fig. 4.5. Right: distribution of sheep humerus Bd and BT metrics; left: Sheep astragalus Bd and GLI; triangles: mouflon from Tell Mureybet, Levels IA/IIIB (Gourichon and Helmer 2008). Small circles: sheep from Tell Halula (OF 20–36; PN) in Saña (1999: 208); Um el-Tlell – Sondaje VI-LPPNB/PN (Helmer and Saña, 1993: 100); Shams Ed-Din Tannira (Halaf levels) in Uerpmann (1982: 35–36); Mezraa Teleilat (Levels II/III–PN/TL) in Ilgezdi (2008: 341); Gritille (Levels A and B, LPPNB) in Monahan, 2000: 318).

Log-ratio size indices (LSI) were also constructed for the sheep sample (Fig. 4.7). Data were then compared to data from the mouflon standard published by Uerpmann (1979). The distribution of the values from this study is slightly lower than the standard reference despite having high variability. This variability might be explained by sexual dimorphism but also surely owes to intra-sex variation.

Mortality profile was built from tooth wear and eruption data obtained from appropriate sheep specimens (Fig. 4.8). Data Ontogenetic data derived from mandibles and mandible teeth remains were analyzed following Payne's proposal (Payne 1973). More than half of sheep for which ages were determined (52.3%) were killed before they reached 1 year of age (A=3.1%, B=16.4%, C=32.8%) while nearly one-third belong to individuals between 2 and 4 years of age (E=17.2%, F=10.2%). Very few individuals over 4 years old have been documented. This pattern is consistent with an exploitation focused on meat, in which breeders carefully cull, selectively keeping certain animals of reproductive age alive.

Mortality profiles are complemented by the distribution of male and females in the sample. Measures HTC and BT of humeri and Bd and GLI from astragali are plotted in Figure 4.9. The results show a bimodal distribution in both distributions where two groups can be recognized: Group 1 individuals are smaller and Group 2 individuals are larger. The statistical significance of these results, when checked by mixture analyses of HTC (humerus) and GLI (in atragalus) values, are significant. In both cases Group 1 is more abundant than Group 2. These data suggest that the majority of adults in this sample were female.

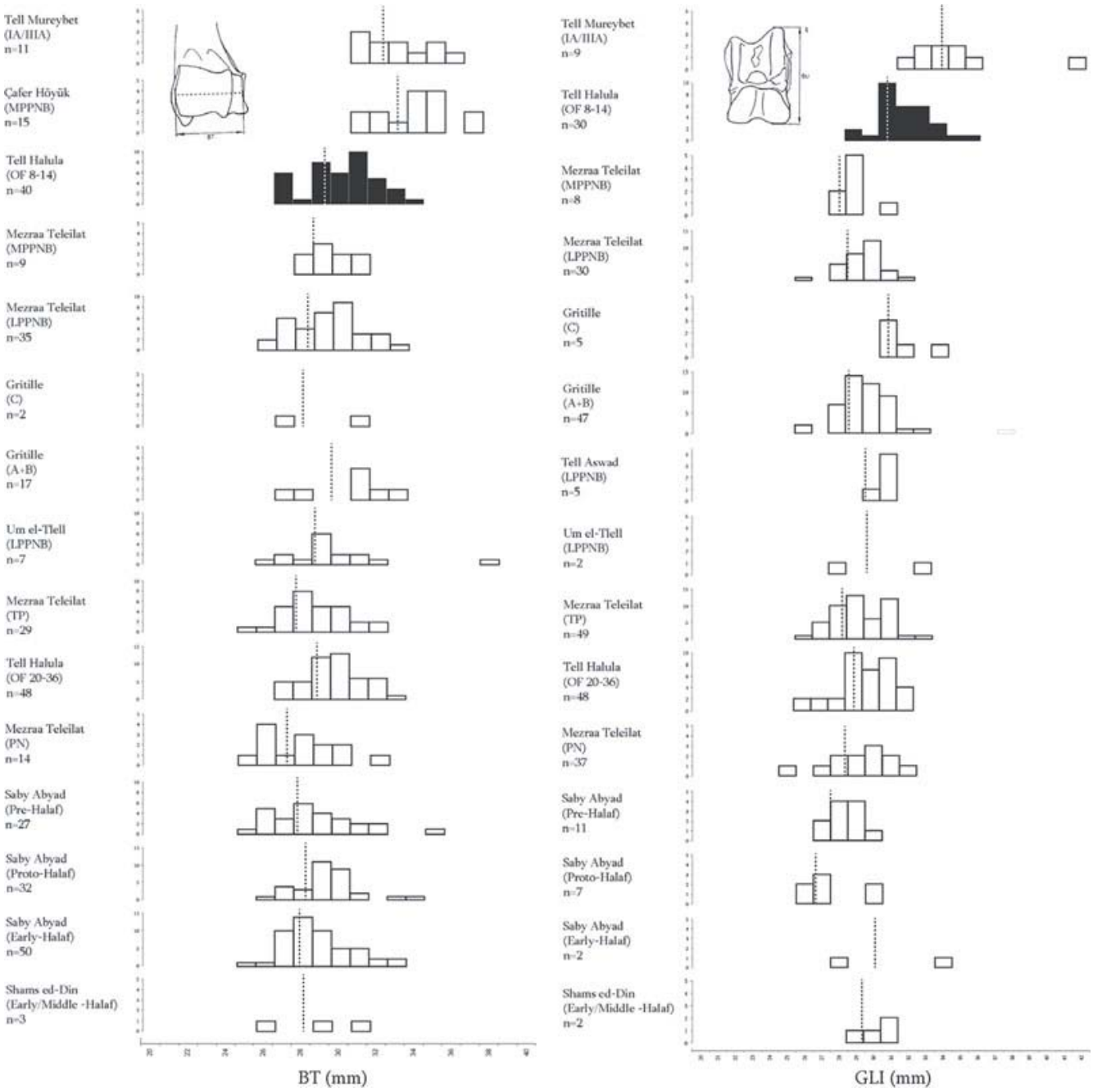

Fig. 4.6. Left: frequency of BT (humerus). Right: Frequency of GLI (astragalus) in mm. Comparison between sheep samples from Tell Halula (OF 8–14) and other assemblages. Humerus (BT) Kruskal-Wallis test P <0.0001, 95% confidence interval; Tell Mureybet (IA/IIIA) sample differs from all other samples except from Çafer Höyük (EPPNB). Çafer Höyük (EPPNB) sample differs from all other sample except from Tell Mureybet (IA/IIIA). Tell Halula (OF 8–14) sample differs in 8/14. The other samples differ from 3/14–4/14 exclusive of samples from Tell Mureybet (IA/IIIA) and Çafer Höyük (EPPNB). Astragalus (GLI) Kruskal-Wallis test P <0.0001, 95% confidence interval; Tell Mureybet (IA/IIIA) sample differs from all other samples. Tell Halula (OF 8–14) sample differs in 9/14. All other samples differ from 2/14–4/14 inclusive of the sample from Tell Mureybet (IA/IIIA). Comparative data from Tell Mureybet (Gourichon and Helmer, 2008), Çafer Höyük (Helmer 1988), Mezraa Teleilat (Ilgezdi 2008), Gritille (Monahan 2000), Um el-Tlell (Helmer and Saña 1993), Tell Halula (Saña 1999), Sabi Abyad (Cavallo 2000) and Shams ed-Dinn (Uerpmann 1982).

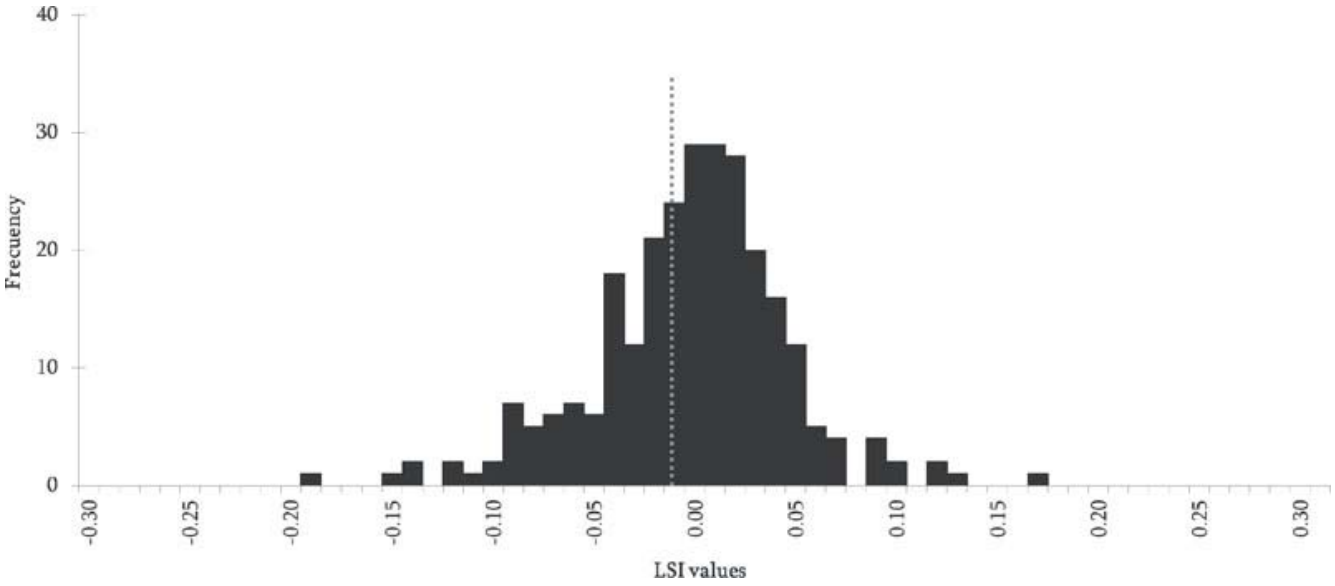

Fig. 4.7. Frequency LSI values from sheep recovered at Tell Halula (OF 8–12). The dotted-grey line represents the mean-value. Standard mouflon data belongs from Uerpmann (1979).

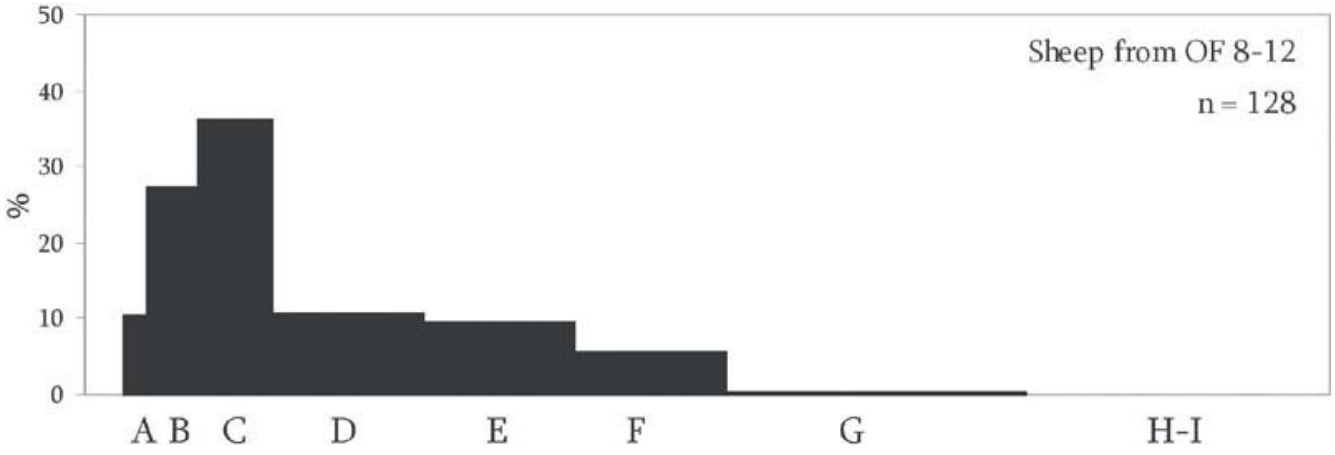

Fig. 4.8. Age profile of sheep from Occupation Phases 8 to 12; ε axis: age groups from Payne (1973) based on mandibular tooth wear and eruption: A=0–2 months, B=3–6 months, C=7–12 months, D=1–2 years, E=2–3 years, F=3–4 years, G=4–6 years, I= >6 years. γ axis: percentage NISP.

Conclusions

The faunal assemblage from Tell Halula is a clear example of how adoption of already-domesticated animals is documented in early herding communities during the PPNB. The adoption of sheep at Tell Halula should be viewed as a response in terms of new alimentary subsistence requirements. Its introduction may therefore, have signified an attempt to stabilize the long-term subsistence base, mitigating possible future risk or simply to satisfy demand resulting from unproductive seasons. However, data obtained in this study suggest that the adoption of new herds were not managed only to provide meat, but the control of reproduction and the formation of larger herds played an important role. A highly significant fact is evidence that the required flow of animals to conform long-term reproductive herds were conformed by already domestic specimens (with reduced size) and not wild progenitors. It is likely that the inhabitants of Tell Halula preferred domestic specimens with demonstrated productivity rather than wild specimens. Intra-size variation in sheep from Tell Halula

could ultimately be the consequence of the use of a broad number of management and exploitative strategies. Overall, the increase in the abundance of sheep through time shows that success in these strategies was achieved. This success in breeding overwhelmingly indicates that the inherent reproductive and production constraints of sheep were overcome, mainly those related with reproduction and alimentation of this specie.

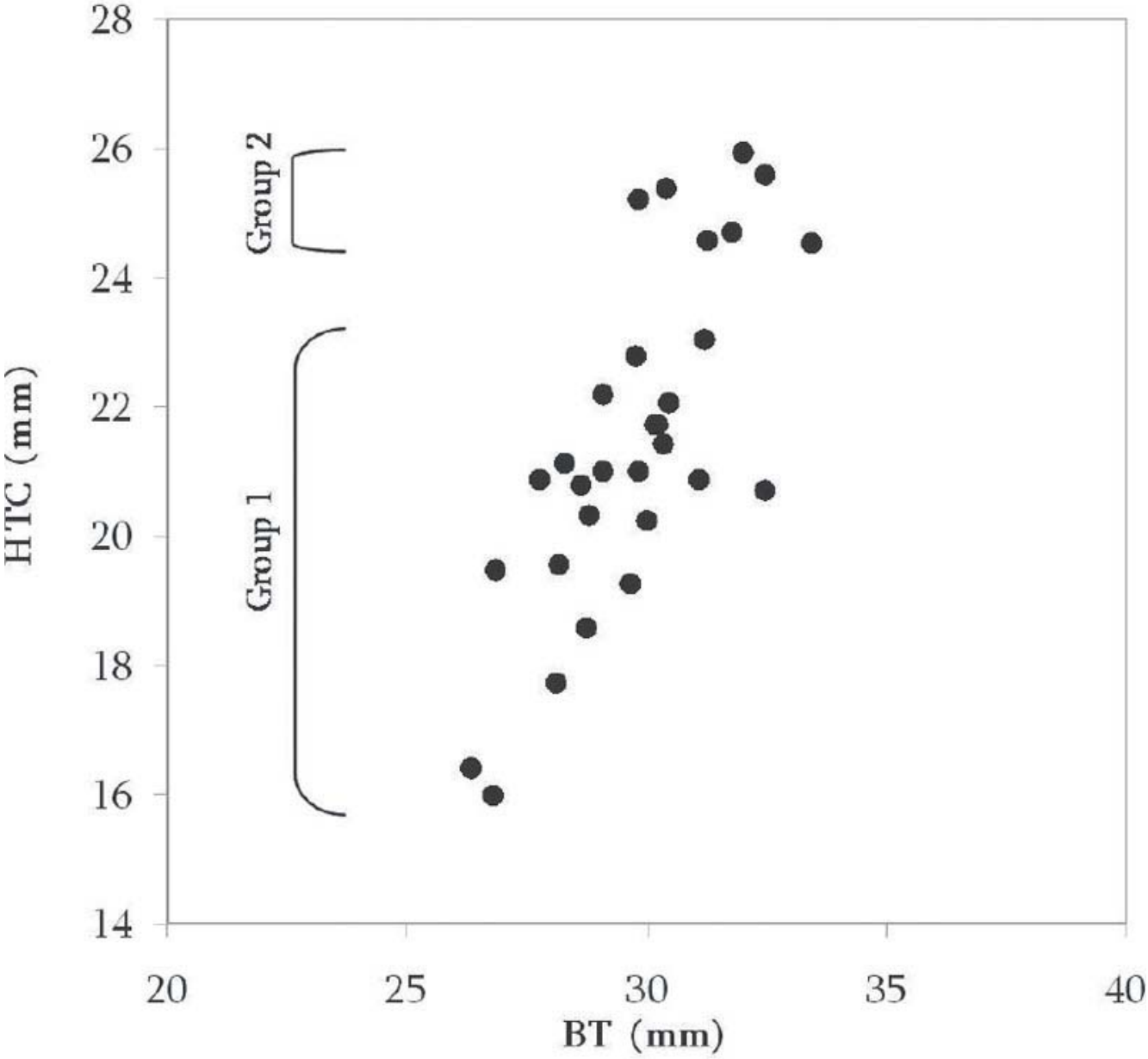

Fig. 4.9 (a). Distribution of humerus HTC and BT in mm. Group 1 and 2: Range of individuals distributed in each group using results from Mixture analyses on HTC (Group 1: Mean 25.14; Stdev: 0.4967; Group 2: Mean 20.49; Stdev: 1.9187).

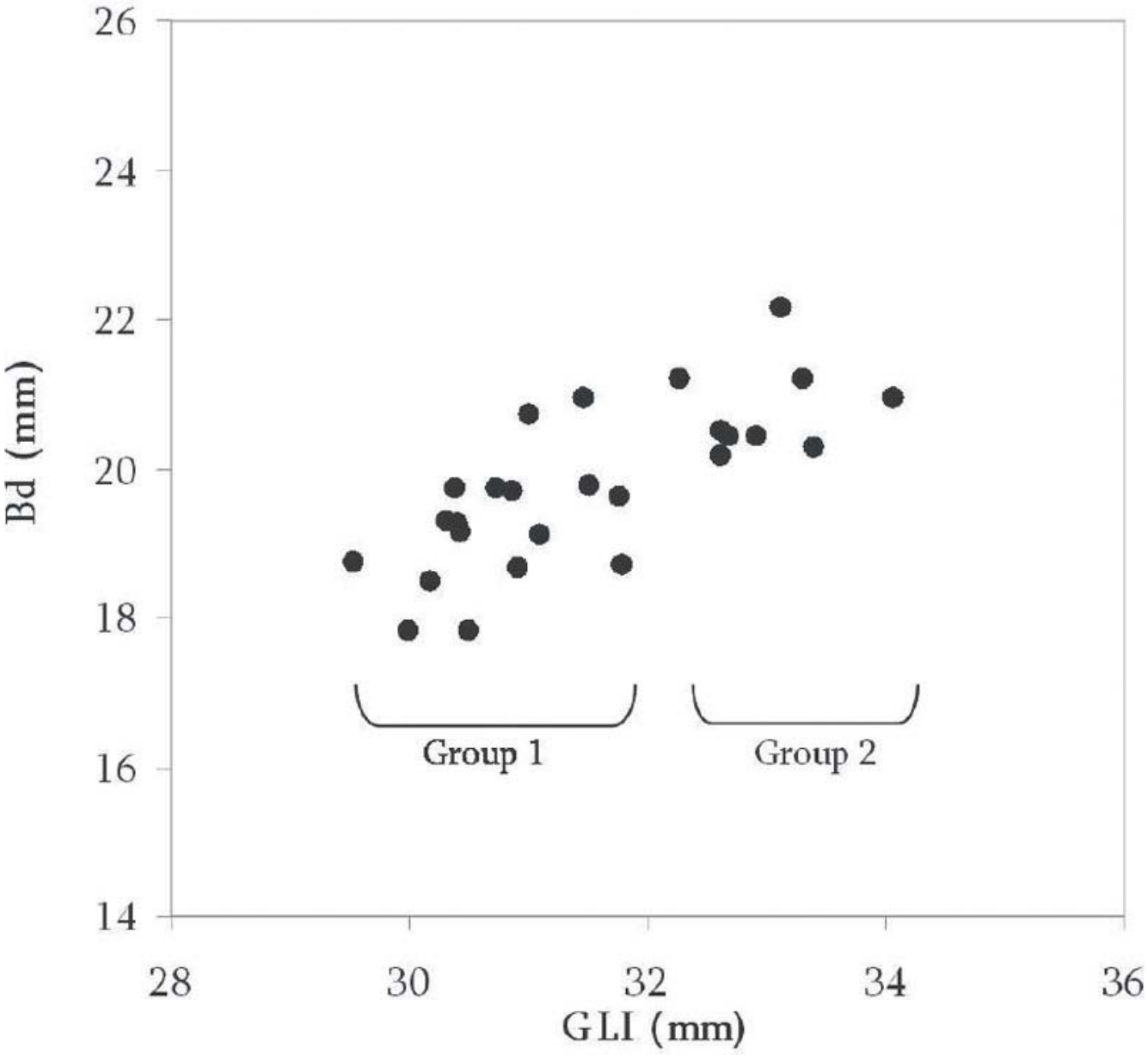

Fig. 4.9 (b). Distribution of astragalus Bd and GLI in mm. Group 1 and 2: Range of individuals in each group using results of mixture analyses on GLI (Group 1: Mean 30.72; Stdev: 0.6016; Group 2: Mean 32.89; Stdev: 0.616).

Considering that herd maintenance and reproduction is a key element in livestock husbandry strategies, the next step is to characterize the organization of this strategy. It should then be possible to investigate the implications of the integration of fully domestic species into the economic strategy of the community, both in productive and organizational terms.

Acknowledgements

The Spanish Project at Tell Halula was only possible due to the help and collaboration of the General Direction of Antiquities and Museums of Damascus (DGAM) in Syria, the *Instituto del Patrimonio Cultural de España* (IPCE) and was funded by the *Ministerio de Educación y Ciencia*, Spain: HAR 2013–43624; IP: Dr Miquel Molist and HAR2011–25826 IP Dr Maria Saña. The GRAMPO research group is supported by the Autonomous University of Barcelona and the Government of Catalonia

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Notes

1. *Ovis aries* remains have been differentiated from *Ovis orientalis* occasionally in assemblages. Morphological and osteometrical criteria have been established in order to separate species (Saña 1999; Tornero 2011). Some criteria like the width of the cortical bone and the degree of pressure and shape of the muscle insertions have been carefully considered. Osteometrical data have been evaluated and compared from recent new data available from Tell Mureybet for *Ovis orientalis* (Gourichon and Helmer 2008).
2. In this study sheep data related to Phase 10 are compound by faunal assemblages which belong from House HE. This House exhibits the most relevant characteristics separating it from all the other houses from PPNB levels at Tell Halula. These traits include an important set of paintings, slightly larger dimensions, metal objects in burials and, relevant for this study, a higher number of wild animal remains. All domestic resources are nevertheless represented in House HE.

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Chapter 5

A Taphonomic and Technological Analysis of the Butchered Animal Bone Remains from Atlit-Yam, a Submerged PPNC Site off the Coast of Israel

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This paper examines the butchering patterns at the submerged Pre-Pottery Neolithic C site of Atlit-Yam off the coast of Israel by analyzing the butchered zooarchaeological remains, which are a subset of the larger assemblage. First, the taphonomic processes which affected the faunal assemblage are analyzed to help understand the limitations of the study. Second, the distribution and nature of the grooves on the bones that are related to butchering slicing activities are subjected to analysis in order to understand the butchering process and technology. Related issues to be discussed include quantification procedures, spatial distribution of activities in the site and the temporal changes evident in the assemblage. The butchering assemblage exhibited a relatively higher level of preservation than any contemporary or later assemblages recovered from dry land sites in the region. Possible differences in butchering practices with respect to the size of the taxon were observed. Microscopic butchering tool type analysis based upon the morphology of grooves suggests that the vast majority were made by unretouched, unifacially produced flint flakes. This suggests that butchering was not conducted with formal tools (e.g. blades), but largely with a tool of convenience (ad hoc tools).

Introduction

While the general outlines of the settlement and economic patterns for the Pre-Pottery Neolithic culture complex have been studied extensively (*e.g.* Becker 1999; Davis 1985; Helmer 1999; Rollefson 2003; Rollefson and Köhler-Rollefson 1993; Verhoeven 2002), relatively little is known about their butchering practices and the manufacturing technology involved. Most zooarchaeological studies of PPN assemblages include information about frequency distributions of taxa, elements, parts of bodies, *etc*., and more rarely the location and frequency of marks (*e.g.* Horwitz and Goring-Morris 2004; Horwitz and Tchernov 1987). However, almost no studies have included a detailed examination of the

types of tools used in the butchering process reconstructed and the implication for butchering practices discussed.

In this contribution, we present the analysis of the butchered faunal assemblage from the submerged Mediterranean Pre-Pottery Neolithic C site of Atlit-Yam, located off the coast of Atlit, Israel (Fig. 5.1). The analysis of these data will be used to increase our understanding of cultural practices during this crucial transition from pre-ceramic to ceramic Neolithic and the transition from wild to domestic economies.

Questions and analytical techniques

Several major sets of questions are the focus of this research and each requires a different analytical approach:

1. To determine if the attritional taphonomic forces (processes pre- and post-deposition) interferes with the analysis of butchered remains.

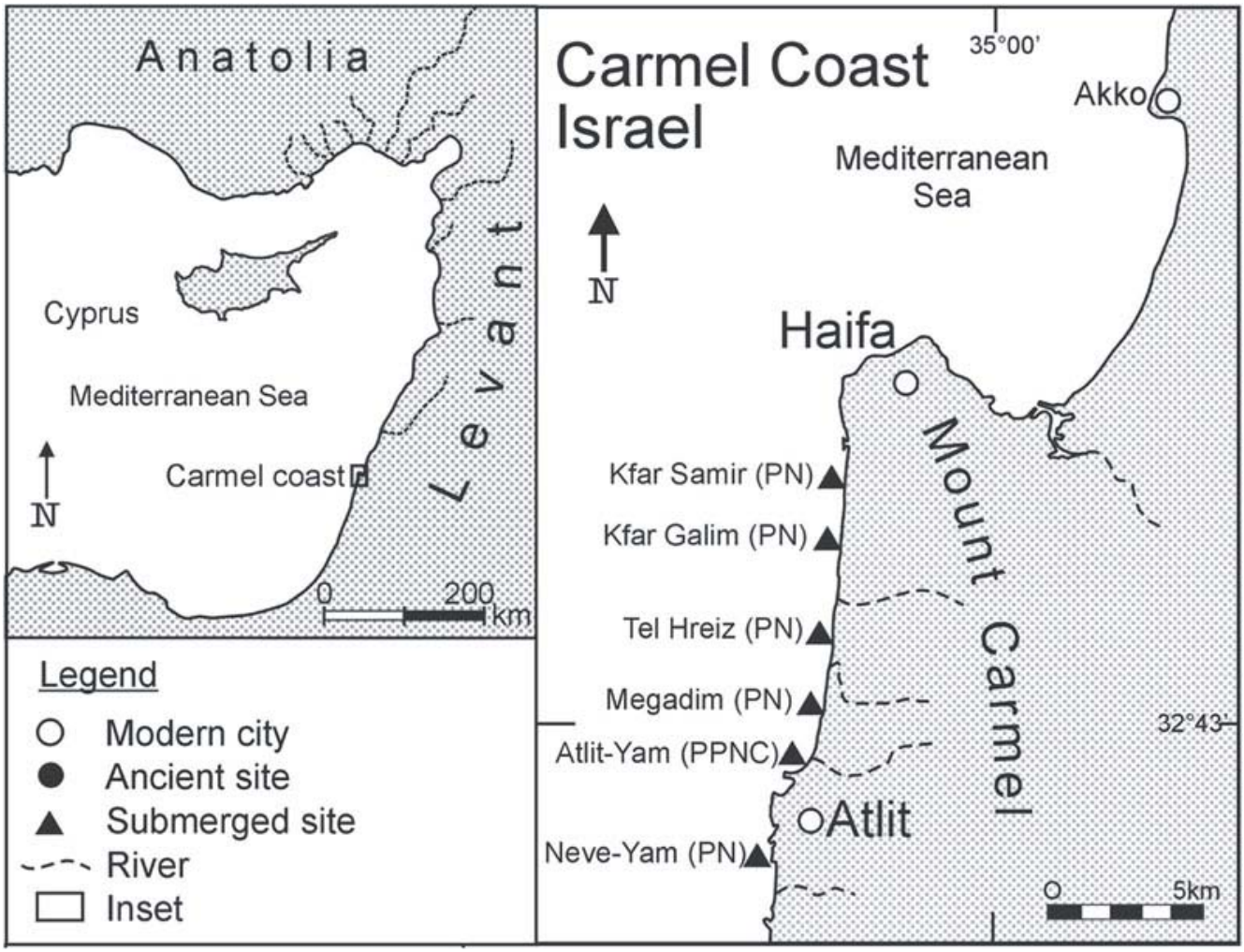

Fig. 5.1. Map of region showing location of Atlit-Yam and some other sites mentioned in the text.

This requires evaluation of several natural and cultural variables, such as consideration of weathering, gnawing, and tool making.

2. To retrieve more information about the butchering process (*e.g.* stages of processing) and the kinds of butchering activities being conducted.

The nature of butchering activities can be determined based on the location of butchering marks. A great deal of ethnographic and experimental research has helped to refine this kind of analysis (*e.g*. Binford 1978, 1981; Burke 2001; O'Connell and Hawkes 1988; O'Connell *et al*. 1991).

3. To determine the nature of the butchering technology (tool type, tool production, and raw material).

   Over the years, a great deal of experimental research has helped to define the criteria to determine butchering tool technology based on the grooves created during slicing actions (*e.g*. Bello and Soligo 2008; Dominguez-Rodrigo and Barba Egido 2005; Domínguez-Rodrigo *et al*. 2009; Greenfield 1999, 2002, 2006; Lemke 2013; von Lettow-Vorbeck 1998; Lewis 2008; Monnier and Bischoff 2014; Shipman 1981a; West and Louys 2007). Slice marks of unifacially produced and unretouched chipped stone tool flakes and/or blades are typically short straight incisions that are made as the cutting edge is drawn across the bone. The tool type, tool material, and tool production will affect the internal morphology mark. Unifacially produced and unmodified chipped stone flakes have an unbalanced "V" shape groove with one side displaying a more gradual slope and the other slope steeper. On the more gradual slope, one or more lateral striations will parallel the apex of the groove. The gradually sloping face corresponds to the dorsal face of the tool, while the smoother and more steeply sloping face corresponds to the ventral face. Unifacial and bifacial production and retouch of chipped stone tools create a series of lateral striations on one or both sides, respectively caused by uneven chipping of the tool edge in the process of re-sharpening the tool. Unifacially and bifacially retouched stone tools create more lateral parallel striations on one or both sides respectively caused by uneven chipping of the tool edge in the process of re-sharpening the tool. It is not possible to distinguish between bifacial production and retouch, but these issues are of minimal concern with flakes or blades (Greenfield 2000: 100, 2006: 152; Olsen 1988; fig. 154F and fig. G, 2013).

4. Is there any pattern in the choice of tool types for various butchering activities? In order to answer this question, the frequency of tool types associated with the different stages of carcass processing must be calculated. Since it was difficult to discern chop or bashing marks in a systematic manner because fragmentation could have been the result of several types of other natural (*e.g*. wave) or cultural (*e.g*. trampling) actions, the focus of the research was on grooves created by slicing actions. Furthermore, the traditional measures of taxonomic quantification in zooarchaeology of NISP (Number of Identified Specimens – *e.g*. Grayson 1979, 1984; Greenfield 1986), MNI (Minimum Number of Individuals – *e.g*. Bökönyi 1970) and TNF (Total Number of Fragments, prior to recovery – *e.g*. Chaplin 1971: 64–67) were not employed in this analysis since they did not account for the fact that individual fragments may exhibit more than a single stage and/or incidence in the butchering process (Lyman 2008; Reitz and Wing 2008).

   For this part of the analysis, the most important measure is Butchering Incidence (BI). This refers to individual butchering events which are represented by widely separated individual or distinct clusters of butchering marks that may exist on a single bone or bone fragment. This measure is important since some bone fragments display more than one incidence, which may be located on different parts or faces of the bone, have completely different orientations, or be made by different tools or tool types. Each of these BIs represents a separate butchering event and possibly activity-type. For example, Sample 178 from Atlit-Yam displays two parallel slice marks located

mid-shaft on the anterior face of a metatarsus and four perpendicular slice marks on the lateral face of the distal shaft of the same metatarsus (Fig. 5.2a and b). The first probably reflects filleting, while the second is probably related to skinning events based on their location and orientation. BI is different than NISP since many fragments have more than one incidence on it (Table 5.1). There were a total of 385 BI recorded for the 307 NISP. If only the traditional quantification methods, such as MNI, TNF or NISP were used, as many as 79 separate and distinct butchering events (BI) would not have been recorded. This would have included 39 filleting incidents, 26 disarticulation incidents, 13 skinning incidents, and one carving incident.

5. To determine if there is an increase in efficiency in the butchering process associated with various tool types, different taxa, different stages in the butchering process, *etc*. Butchering Mark Frequency (BMF) was used to investigate these issues, in addition to the previously discussed techniques. It records the number of grooves (which represent individual strokes or slices) observed per BI (=# of slices/BI). A measure of butchering efficiency can therefore be derived through the relationship between these two measures. In a perfect world, the BMF should decline with increased efficiency – fewer strokes/incidence should indicate greater efficiency.

Atlit-Yam

Atlit-Yam is a Pre-Pottery Neolithic C coastal village which was submerged and abandoned shortly after the end of the PPNC (Galili *et al*. 1993, 2002, 2005). The site is submerged at 8–12 m below sea level *ca*. 400 m off the Israeli Mediterranean coast to the north of the Crusader fortress of Atlit, *ca*. 10 km south of the city of Haifa. Atlit-Yam is one of a number of submerged sites along the Carmel Coast (Fig. 5.1) with faunal remains (Greenfield *et al*. 2006; Horwitz *et al*. 2006).

The site covers an area of *ca*. 40,000 sq m and represents the remains of a sedentary village that was flooded by the rise of sea level from the melting of glaciers during the early Holocene. The site was submerged relatively quickly, but without any catastrophic event. This created excellent conditions for preservation that are normally not found in terrestrial sites (Galili *et al*. 2008).

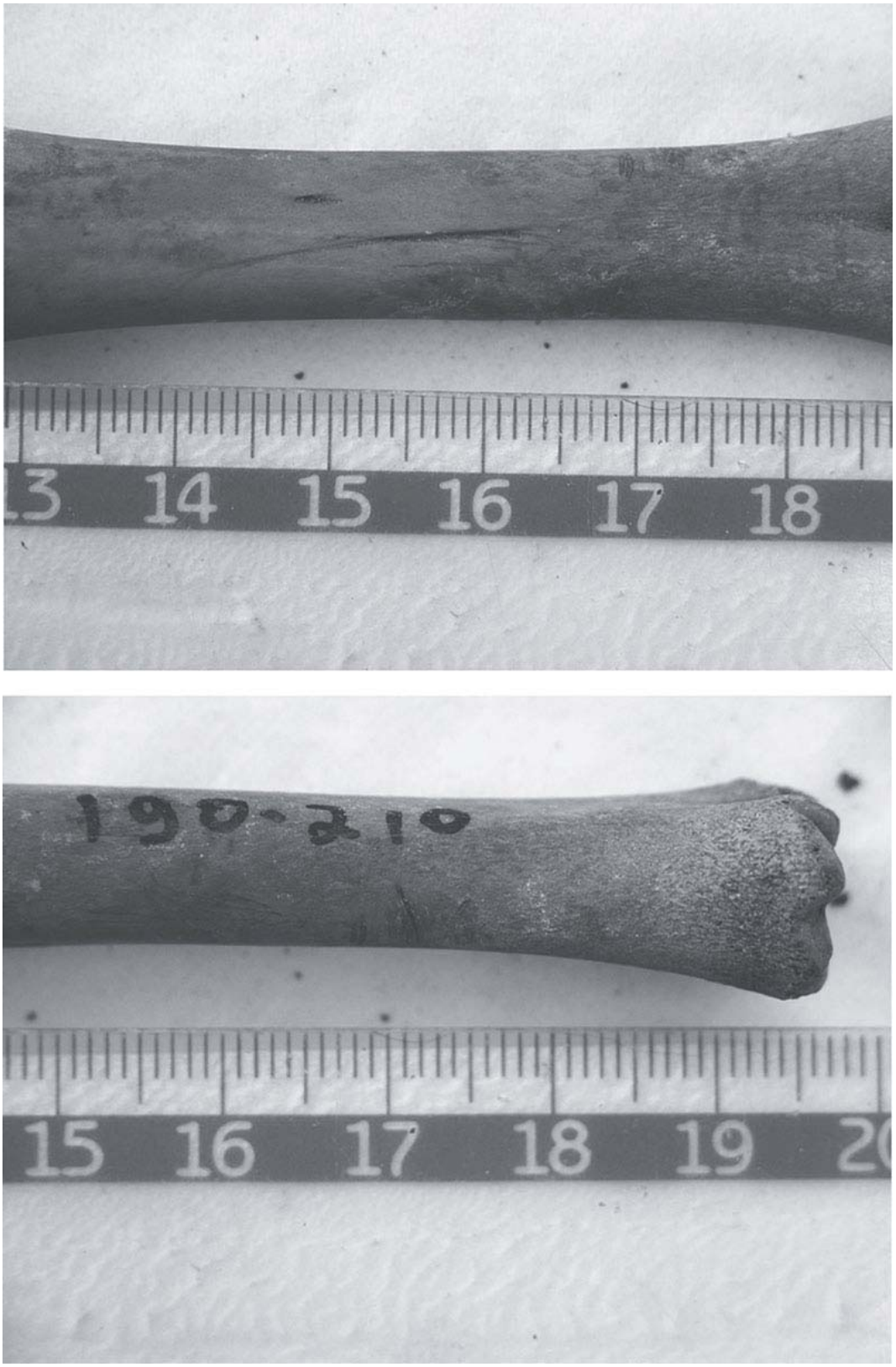

Fig. 5.2. Photographs (a and b) of butchering sample 178 from Atlit-Yam showing how more than one butchering incidence may be represented by differently oriented butchering marks on the same bone. The two differently oriented slicing marks may represent different stages in the butchering process.

Table 5.1. Taxonomic frequency of butchered data (NISP, BI, and Elements).

Taxon	Sum NISP	% NISP	Sum # elements	Sum # frags	Sum # butchering incidence	% BI	Rank order NISP	Rank order BI	Size of sample
Bos primigenius	39	12.70	39	64	64	16.62	4	2	Good
Bos sp.	21	6.84	21	26	26	6.75	7	7	Good
Bos taurus	40	13.03	40	56	56	14.55	3	3	Good
Bos/Cervus	1	0.33	1	1	1	0.26	12	13	Poor
Canis familiaris	2	0.65	2	5	5	1.30	11	11	Poor
Capra aegagrus	1	0.33	1	1	1	0.26	12	13	Poor
Capra hircus	12	3.91	14	15	15	3.90	9	9	Good
Capreolus capreolus	5	1.63	5	6	6	1.56	10	10	Poor
Cervus elaphus	2	0.65	2	2	2	0.52	11	12	Poor
Cervus/Dama	1	0.33	1	1	1	0.26	12	13	Poor
Dama dama	1	0.33	1	2	2	0.52	12	12	Poor
Gazella gazella	1	0.33	1	1	1	0.26	12	13	Poor
Mammal, large	42	13.68	42	45	45	11.69	1	4	Good
Mammal, medium	26	8.47	26	27	27	7.01	6	6	Good
Ovis aries	35	11.40	35	43	43	11.17	5	5	Good
Ovis/Capra	56	18.24	60	66	65	16.88	1	1	Good
Sus scrofa dom.	20	6.51	20	23	23	5.97	8	8	Good
Sus scrofa fer.	1	0.33	1	1	1	0.26	12	13	Poor
Unknown	1	0.33	1	1	1	0.26	12	13	Poor
Grand total	307	100.00	313	386	385	100.00			

Atlit-Yam's occupation has been dated on the basis of a combination of lines of evidence: absence of pottery, type of lithic material, results of radiocarbon dating, and presence of domestic animals. The site appears to have been occupied for almost a millennium, lasting from the end of the eighth into the first half of the seventh millennium BCE (*ca*. 7,200–6,500 cal BCE). It is largely associated with the PPNC cultures of the southern Levant (Galili *et al*. 2002).

Based on radiocarbon dates and typological analysis of the lithics, it appears that there are two major phases of occupation. The earlier phase is represented by the deposits in and around most of the houses, which belong for the most part to the late PPNB and to the PPNC. The later deposits are concentrated in the well, which appears to belong to the very end of the PPNC. The well appears to

have been filled in as it was contaminated by the rising sea level.

Excavation, recovery, and curation

The currently submerged status of Atlit-Yam required special excavation techniques to allow for accurate mapping of artefacts, features and deposits, and high degrees of stratigraphic control and artefact recovery. Excavation and recovery accommodated for the difficulties of water currents and wave action on the site, which often caused murky water and shifting sands. Mapping was achieved by identifying structures underwater, triangulating their dimensions, and positioning them from the shore using buoys anchored to the structures underwater. Excavation was carried out in grids on the sea floor using a water pump to remove the overlaying loose sand from the excavation area and then excavate the archaeological deposits. This technique involved two divers, one handling the suction end and one handling the exhaust end. Sand was suctioned up in fine layers from the gridded area and deposited outside the excavation area into boxes or bags which were taken to the shore and sieved. All material was sieved and sorted on shore (Galili *et al*. 1993: 135).

Architecture

The site shows a remarkable degree of preservation of fragile organic remains, that in other sites are normally poorly preserved, including animal and botanical remains, artefacts, and human burials (Galili *et al*. 1993: 133). Neolithic sites in Mediterranean coastal regions tend to be rare and exhibit poor preservation of architectural remains (*e.g*. Gopher and Gophna 1993). At Atlit-Yam, a unique situation exists where the fragile architectural and artefactual (including wood and bone) remains are well-preserved (Galili 1987; Galili and Nir 1993; Galili *et al*. 1993, 2002, 2005, 2008; Hershkovitz and Galili 1990). As a result, many structures and installations have been identified across the site, including houses, wells, megalithic installations, and burials (Galili *et al*. 1993, 2005). Some of these are described next.

A number of structures were found and excavated at the site. They consist of a number of rectangular structures (dwellings), walls and wall foundations, paved surfaces, circular structures, and deeply excavated shafts (Galili *et al*. 2002: 173), representing residences, workshops, a ritual center, and water-wells (Fig. 5.3). Some were excavated, while others were merely tested or their surfaces mapped. These are described in greater detail in the discussion of contextual distributions of butchered remains.

Most of the structures had bones associated with them. Only a few of the structures are associated with bones with butchering marks (Table 5.2). The information on structures is summarised in relation to the bone information in order for contextual considerations to be discussed.

Structure 9 consisted of a row of stones outlining most of a rectangular structure and stones in a circular pattern which may have been a later introduction to the structure (Galili *et al*. 1993: 137). A one meter square was excavated within the structure.

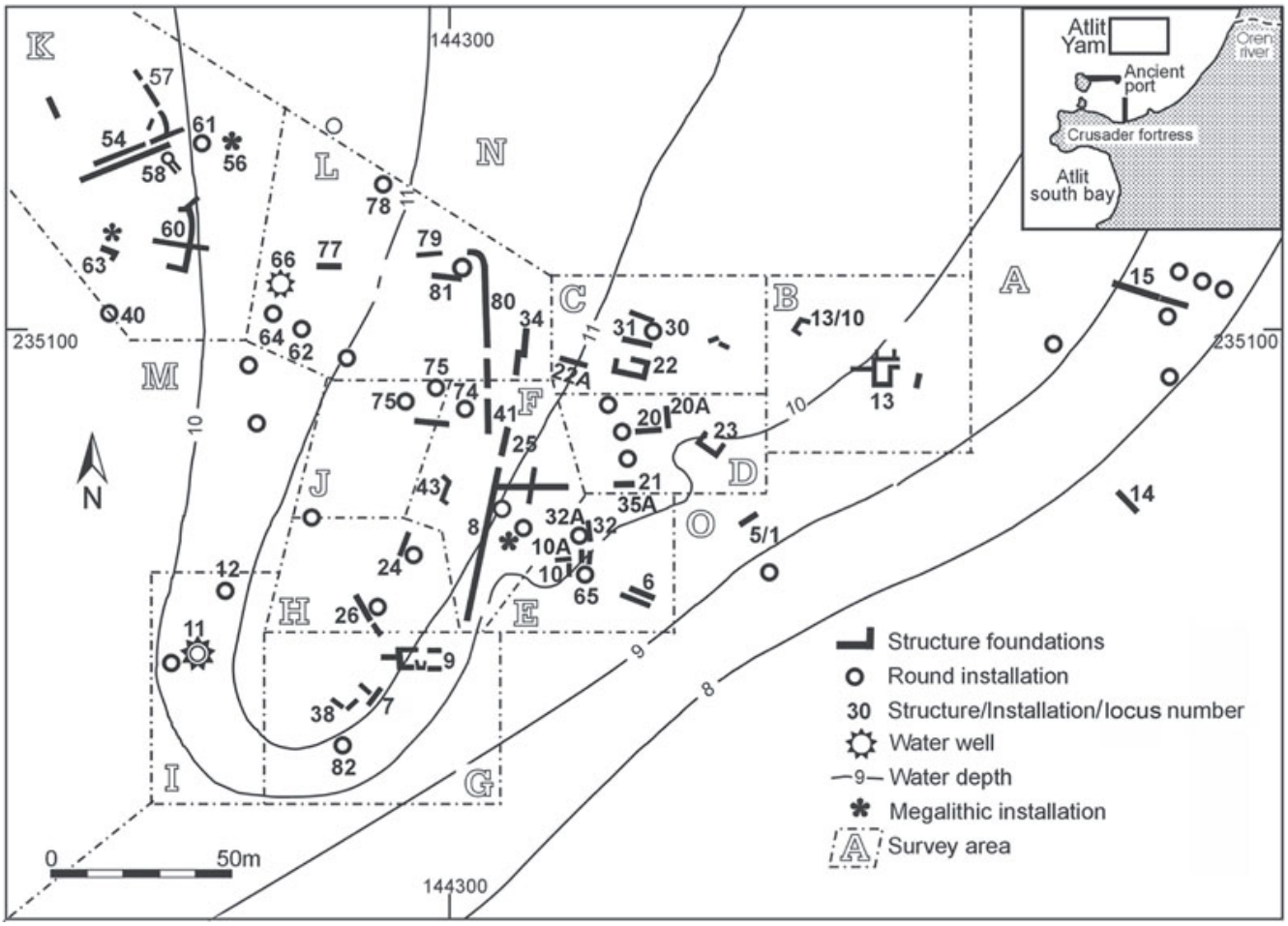

Fig. 5.3. Map of Atlit-Yam site and structures.

Structure 10 is a stone built wall that contained two hearths of grey ash and a number of bifacial flint artefacts (Galili *et al*. 2004: 6).

Structure 10A is an open surface adjacent to structure 10. A 2 × 2 m sq was excavated to a depth of 0.3m within Structure 10A and contained a large concentration of fish bones and cereal grains with a few flint artefacts, animal bones and human bones (Galili *et al*. 2004: 5).

Structure 11 has been identified as a well with four circular courses of stone preserved above the clay surface and a number of courses extending below the surface to a depth of 3 m. Below the stone-built courses, the shaft is excavated into the Kurkar sandstone to a total depth of 5.5 m below sea bottom (Galili *et al*. 1993: 139, 2004: 7). It was filled with soft clay, fire-cracked limestone, rock fragments, bone and stone artefacts, and plant and animal remains. Remains from the well have been dated between 6,458–5,992 cal BCE (Galili *et al*. 2002: 175). Animal remains consisted of large quantities of sheep, goat, cattle, and pigs, some carnivores (mostly dog) as well as numerous bones of rodents, reptiles, and insects (Galili *et al*. 2004: 8). It has been suggested that the accumulation of remains inside the well date from the end of the settlement, just before it was flooded by the sea. It is evident from the frequency of NISP and BI that half of the remains discussed in this paper derive from this structure (Table 5.2). The nature of the structure enhanced preservation of faunal and other delicate remains at the site.

Table 5.2. Frequency distribution of butchered bones by structure or associated space (NISP and BI).

Structure #	*Sum of NISP*	*NISP*	*Sum of BI*	*BI*
1	3	0.98	4	1.04
7	4	1.30	12	3.11
9	35	11.40	54	13.99
10	2	0.65	3	0.78
11	158	51.47	187	48.45
20	2	0.65	2	0.52
32	5	1.63	7	1.81
56	1	0.33	1	0.26
10 m NW of 32	3	0.98	4	1.04
20, 21	1	0.33	1	0.26
20, 21 plus 37	2	0.65	2	0.52
20, 25, 37	1	0.33	1	0.26
43,22	2	0.65	2	0.52
5,10,20	4	1.30	4	1.04
Between 6, 8, and 10	3	0.98	8	2.07
Between 8 and 9	2	0.65	4	1.04
None	69	22.48	79	20.47
א10	4	1.30	5	1.30
א35	5	1.63	5	1.30
ב10–א35	1	0.33	1	0.26
Grand total	307	100.00	386	100.00

Structure 13 was a rectangular dwelling, 5 × 8 m, with three courses of stones remaining (Galili *et al*. 1993: 139). Hearths and human burials were discovered near the structure, but no animal bones were associated with the structure. Two 1 m sq were excavated inside the structure.

Structure 20 is a wall built of two courses of stone 4 m long with a concentration of burnt organic material, flint artefacts and fish and animal bones (Galili *et al*. 2004: 7). The burnt organic material was located just outside the structure.

Structure 35a – This represents a large and dense concentration of flint artefacts embedded in the clay in an open and flat area with no associated stone-built structure. The archaeological material was recovered from 8-one metre squares (2 × 4 m area) (Galili *et al*. 1993: 139, 2002: 8). This concentration is interpreted as a chipping floor since there are thousands of flakes, chips and cores, a few tools, a few animal bones and a single fish bone (Galili *et al*. 2004: 8).

Structure 56 – This structure appears to be a ritual installation of upright megalithic stones forming a circle (Galili *et al*. 2002: 174). Six out of seven stones were still standing with a diameter of *ca*. 2.5 m.

Lithics

A variety of lithic artefacts were recovered from the site, including both chipped (made from flint) and ground stone tools. Tool types recovered from amongst the buildings and open-spaces include chipped and pressure-flaked flint stone tool flakes, blades, cores, sickle blades, awls, bifacial (axes, adzes and chisels) and projectile points (arrowheads or spearheads; Galili *et al*. 2005:6). Among the lithics, retouched flakes and blades were most common (36%), followed by denticulates and notches (26%), and finally bifaces (13.7%). All the rest made up the remaining categories (Galili *et al*. 2002: 176). Ground stone tools consisted of bowls, hammers, perforated stones, and grinders (Galili *et al*. 2002: 177). Grave goods included a miniature limestone axe in a child's burial (Galili *et al*. 2005: 9). Other grave goods included flaked flint blades and cores, and grinding stones. Chipped stone tools and flakes are scattered across the site. However, the largest cluster of chipped stone flakes and tools is in Structure 35a (2.5 m sq; 30 cm thick). Most of the chipped stone tools appear to be made from local Mt. Carmel flints (Galili *et al*. 1993: 140).

Fauna

Final reports on the faunal remains are not yet available. The preliminary studies indicate that the vast majority of vertebrate remains recovered from the site belong to mammals. Among these, there is an uneven mix of wild and domestic specimens represented at the site, with far fewer wild animals (Galili *et al*. 1993: 149; Horwitz and Tchernov 1987; Horwitz *et al*. 2006). The majority of wild taxa are fish, with grey trigger fish accounting for the largest number of fish remains (97%; Galili *et al*. 2002: 180 Zohar *et al*. 1994, 2001). Mammalian remains consist mainly of domestic sheep and goat, domestic cow, wild and domestic pigs, and dog (or wolf?). There is a light representation of a variety of wild taxa, including gazelle, fallow deer, various carnivores, rodents, reptiles, insects, and amphibians (Galili *et al*. 2002: 178). More recent reports indicate that there was a change in emphasis of fauna over time at the site. The earlier stages of the settlement consisted of more wild species, while the later stages (as evidenced in well structure 11) contain more domestic animals (Horowitz *et al*. 2006). The age distribution of domestic animals also changes over time with more juvenile domestics in the later period of occupation (Galili *et al*. 1993: 149, 2002: 179).

Faunal remains were collected across the surface of the site before, during and after excavation of selected areas and features. As wave action from storms exposed material each year, underwater surveys were carried out and new remains were collected and mapped by hand. This has been an ongoing process as part of site mitigation. Initially, the odd specimen was hand-collected during survey. But, during subsequent excavation, they were systematically gathered through suction and recovered in the sieve mesh. Very few of the specimens (NISP=6 or 1.95% of assemblage) exhibited fresh breaks that could be assigned to recovery or post-recovery actions.

After recovery, specimens were desalinated and slowly dried out to minimise fragmentation. For the most part, very few specimens exhibit drying cracks. Also, very few specimens were damaged during transport as evidenced by only four specimens (1.3% of NISP) who were observed to have more than one fragment with fresh breakage present.

Analysis of the butchered remains took place where they are curated in the National Natural Collections of the Institute of Earth Sciences of The Hebrew University (Jerusalem). They are stored carefully in wooden drawers in cardboard boxes or surrounded by foam cushion.

Standard zoological, taphonomic and other data (*e.g*. age, pathology, *etc*.) on all specimens were systematically recorded. In addition, all specimens were photographed with the locations of butchering marks. Silicone molds of all butchering marks were made and the molds brought to the University of Manitoba where they were examined under a light optical microscope and a sample were subjected to analysis in a Scanning Electron Microscope. At least, two different analysts were used to ensure consistency of observations. No specimens were damaged during analysis.

Results

Sample size

As of 2002, a NISP of ~700 bones was recovered from the site (Galili *et al*. 2002; Horowitz *et al*. 2006). Of these, 307 (NISP) displayed butchering marks (*ca*. 44% of the total assemblage). The sum of NISP is the same as the sum of TNF (Total Number of Fragments) since only butchered remains are recorded. The TNE (Total Number of Elements with butchering marks) was slightly higher with 313 specimens (Table 5.1) since there were only a few articulated elements – two *Capra hircus* fused ulnae and radii and one *Ovis/Capra* maxilla with several teeth among butchered remains. The frequency of butchered remains is far greater at Atlit-Yam (44% NISP) than in most other contemporary or later terrestrial assemblages, where usually less than 5% and often less than 1% of remains of medium and large mammals display butchering marks. One the one hand, this allows identification of butchering patterns that are not normally visible in most sites. On the other, this provides a cautionary tale for all who ignore the important role of depositional taphonomy in assemblage of attrition.

Butchering and taphonomy

A number of taphonomic variables were identified and recorded in order to determine the effect of various attritional forces on the assemblage. The choice was limited largely to those that would affect the butchering tool analysis. This was important since the quality of preservation can mitigate the nature of any analysis and reconstruction of prehistoric activities (see Lyman 1994 for a summary of the vast literature and variables that can affect assemblages). This is especially true with respect to microscopic grooves which could be made by a number of different agents (Pawłowska *et al*. 2013; Shipman 1981b). In general, they all illustrate the high quality of the assemblage and how very few destructive forces operated on the assemblage to interfere with the kind of analysis conducted for this research. Each is described below.

Natural taphonomic variables

The submerged nature of the site created the excellent conditions of preservation, which affected the nature and frequency of bone weathering (and by implication affected the frequency of butchering marks). Most of the assemblage exhibited very light (34%) or light weathering (48%) of bone surfaces (Table 5.3). A much smaller proportion of the assemblage was medium (17%) and a very small proportion was heavily weathered (<1%). The high degree of light weathering indicates that the Atlit-Yam butchering assemblage was very well preserved.

When compared against Neve Yam (a neighbouring and also submerged PN site) and to terrestrial

sites in the region and elsewhere, Atlit-Yam exhibits a much higher degree of preservation (Fig. 5.4). At Neve Yam, the butchered bone assemblage was more heavily damaged – 40.7% light, 59.3% medium weathered (Greenfield *et al*. 2006). Surfaces of the bone that would normally be eroded away by exposure or other taphonomic processes were preserved at Atlit. It is on these bone surfaces that the very shallow grooves created by slices are found and would be lost under poorer conditions of preservation. This is the cause of the high incidence of butchering at the site. The pattern is especially visible when the degree of preservation of the Atlit (and less so for Neve Yam) material is compared to contemporary or later dry land assemblages (Greenfield 2013; Greenfield and Brown 2016; Greenfield *et al*. 2015). They are akin in frequency to the level of preservation found in Mesolithic water-logged sites from northern Europe (*e.g*. Star Carr: Legge and Rowley-Conwy 1988).

Overall, very few bones exhibited any evidence of gnawing (NISP=14; 4.5% of assemblage). Of these, most could be attributed to canids (NISP=13) and only one to a rodent. Most of the canid remains could be assigned a medium intensity (11 out of 13) with only one noted as light and another as heavy. This would imply that gnawing was not a significant attritional variable operating on the assemblage. It also suggests that it is unlikely that grooves created by butchering activities were confused with gnawing grooves. They are not only morphologically distinct (*e.g*. scalloped edges and pits for canids, parallel grooves for rodents), but also found in different locations (*e.g*. at ends of bones) and with different orientations (*e.g*. random).

Table 5.3. Frequency distribution of butchered remains by intensity of weathering (NISP).

Weathering	Sum NISP	%
1) Very light	105	34.20
2) Light	149	48.53
3) Medium	51	16.61
4) Heavy	2	0.65
Grand total	307	100.00

Cultural taphonomic variables

Cooking is one of the major forms of bone destruction in assemblages. It can be identified by the degree of bone modification from heating (Shipman *et al*. 1984). In contrast to expectations, very few butchered remains exhibited any evidence of this major destructive taphonomic variable. Only ten specimens were burned and all were fully or partly blackened. This either suggests that few bones were cooked or that the cooked bones had completely disintegrated. It is thought that the former is more likely given the other indicators for high preservation at the site. But, it also suggests that few bones with butchering marks also yield evidence of cooking. This may suggest that most meat and other soft tissue were filleted off the bone prior to cooking.

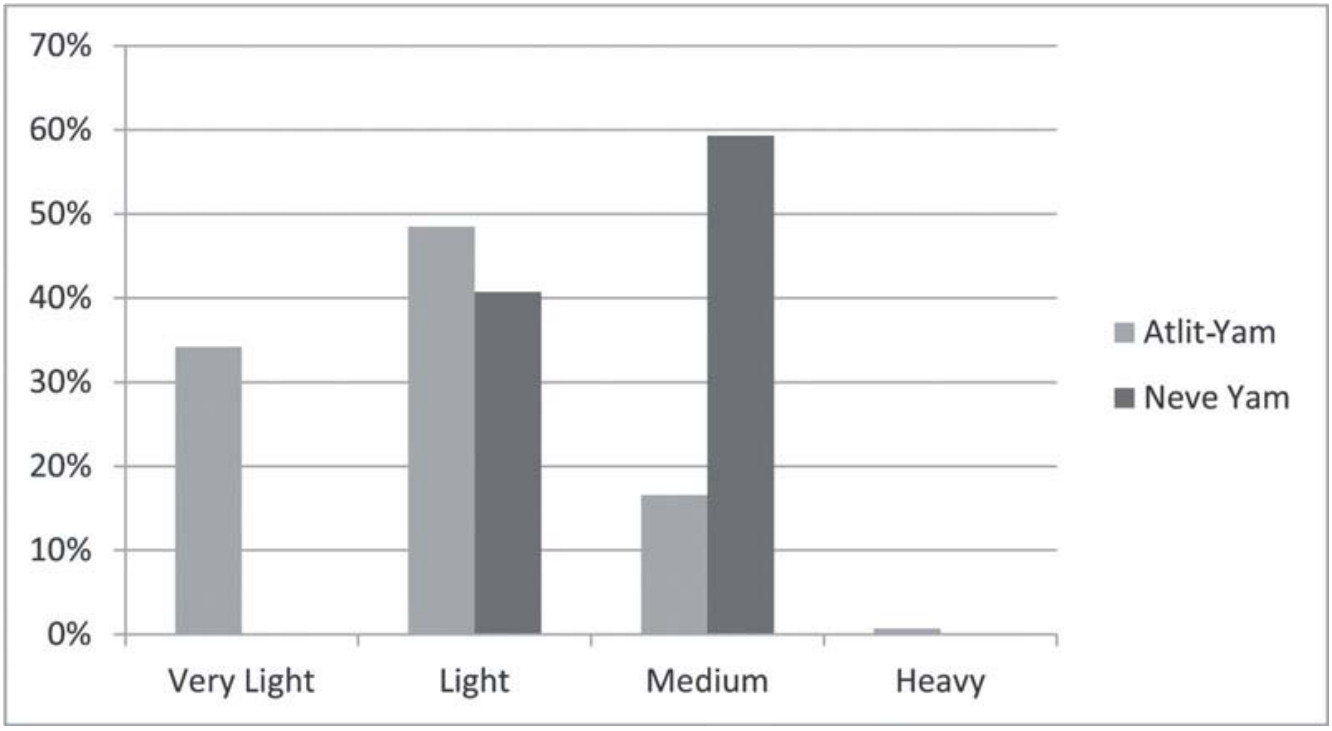

Fig. 5.4. Comparison of percentage frequency distribution of butchered remains by intensity of weathering for Atlit-Yam and Neve Yam (NISP).

Cultural modification and use-wear polish is another important taphonomic variable. It can be used to monitor the degree of cultural modifications on an assemblage. Very few specimens (NISP=9) were modified into a recognizable tool, ornament or production by-product (*e.g*. a possible awl and handle: 1 each; specimens cut in half, cut through to be shaped, and shaped for use as a tool – NISP=4; and flattened during use – 3 NISP). In addition, only 11 specimens exhibited any evidence of use-wear polish. It is interesting to observe that this pattern is very different than that seen in some terrestrial assemblages (*e.g*. Tell es-Safi/Gath and Halif), but is similar to the pattern seen in other Neolithic submerged assemblages (Neve Yam) where similar analyses have been performed (Greenfield and Brown 2016; Greenfield and Horwitz 2012; Greenfield *et al*. 2016; Shai *et al*. 2014). The combination of these two variables suggests that few butchered specimens were modified by use-wear afterwards or that the observed grooves were a result of preparing or cleaning of specimens as tools or ornaments.

Taxonomic distribution

All of the butchered remains come from medium and large mammals despite the fact that a broad range of taxa were identified at the site. The two most common subfamily groups are Caprines and Bovines

(domestic and wild combined). Together, they account for over 66% of butchered remains (Table 5.1). Caprines are the largest taxonomic category of butchered fragments (NISP 33%) when all types of wild, domestic and indeterminate *Ovis* and *Capra* specimens are combined. *Bos* represents the next largest taxon among the identified fragments (32.6%), also including domestic, wild and indeterminate forms. There is a dramatic decline in frequency to the next most common taxon – *Sus scrofa* (6.8%). All, but one of the *Sus* specimens, are domestic. This is followed by a few specimens of domestic dog, *Canis familiaris* (0.6%). The remaining specimens include only wild animal remains and all were low in frequency: *Capreolus*, *Cervus*, *Dama*, *Cervus/Dama*, *Gazella*, and a possible *Bos/Cervus*. A number of specimens could only be identified to Large and Medium Mammal (13.5% and 8.5%, respectively).

In contrast to NISP, the taxon with the most frequent BI in the assemblage is *Bos* combined (37.9%). Caprines combined come in second (32.2%). Once again, there is a dramatic decline in frequency to the next most common taxon – *Sus scrofa* (6.2%). These three taxa include both domestic and wild forms. Almost all of the other taxa are represented by very low BI frequencies, except for large and medium mammal that probably are *Bos* and caprines, for the most part. This would inflate the frequencies of these two taxa vis-à-vis the other taxa even more. This is followed by a few specimens of domestic dog, *Canis familiaris* (BI=5), which is relatively unusual. The remaining specimens include only wild animal remains and all were low in frequency: *Capreolus capreolus*, *Cervus elaphus*, *Dama dama*, *Cervus/Dama*, *Gazella gazelle*, and a possible *Bos/Cervus*. A number of specimens could only be identified to Large (11.7%) and Medium Mammal (7%) respectively.

But taxonomic frequency is not necessarily the same as butchering incidence, even though they are broadly similar (Table 5.1). The difference between NISP and BI has only a slight effect on taxonomic frequency. Some taxa have a slightly higher BI, while others have a slightly lower BI than NISPs. The incidence of butchering appears to be affected by the size of the animals. Larger animals have a higher BI than NISP (*e.g. Bos primigenius* – NISP 12.7 and BI 16.6%; *Bos taurus* – NISP 13.3 and BI 14.5%), and the opposite is true for medium and smaller mammals (*Ovis aries* – NISP 11.40 and BI 11.17%; *Ovis/Capra* – 18.2 and BI 16.9%; *Sus scrofa dom.* – NISP 6.51 and BI 5.97%).

It would seem that taxonomic frequency of BI is also affected by sample size since the relationship is most evident when all taxa with a NISP of <10 are removed from the analysis. The effect of sample size is very pronounced with medium sized taxa which have small sample sizes, such as *Canis familiaris* (NISP 0.65 and BI 1.30%) and *Sus scrofa dom.* (NISP 6.51 and BI 5.97%) where the expected relationship is reversed. In other cases with small sample size of medium sized taxa, there is no difference in frequency between NISP and BI (*e.g. Capra hircus*).

Butchering tool technology

Most of the butchering marks could be assigned to a type of tool. The most common were slicing grooves from a knife-like blade, represented by a BI of 381 (98.96%). This was followed by chop from an axe-like blade (BI=3, 0.78%) and scrapes (BI=1, 0.26%). No saw marks were observed, nor were bashes systematically recorded, unfortunately.

In all cases, the type of raw material used in the butchering process was that of stone (probably flint). All the butchering marks (slicing grooves, axe marks, and scrapes) were made by chipped stone tools. This is evident from the internal morphology of the grooves, with their stepped sides and lateral striations, and asymmetrical apex (Fig. 5.5). Bashes would have been made by ground stone tools which would have been less sharp with rounded edges and would not have left the same kinds of

diagnostic marks that made them recognizable as axe chops.

The large number of slicing grooves allowed for a systematic evaluation of the type of tool and its production style and retouch used in the butchering process (Table 5.4). Nearly all of the BIs were made by unretouched, unifacially produced flakes (91.7%). Most have a gently rising side with one or two lateral striations and a steeply rising side without any lateral striations on the other side of the groove (Fig. 5.5). Most of the remainder was made by unifacially retouched flakes (7%), which have many steps and lateral striations on one side (Fig. 5.6). Very few had many steps and lateral striations on both sides suggesting that they were made by bifacially retouched flakes (1%) (Fig. 5.7).

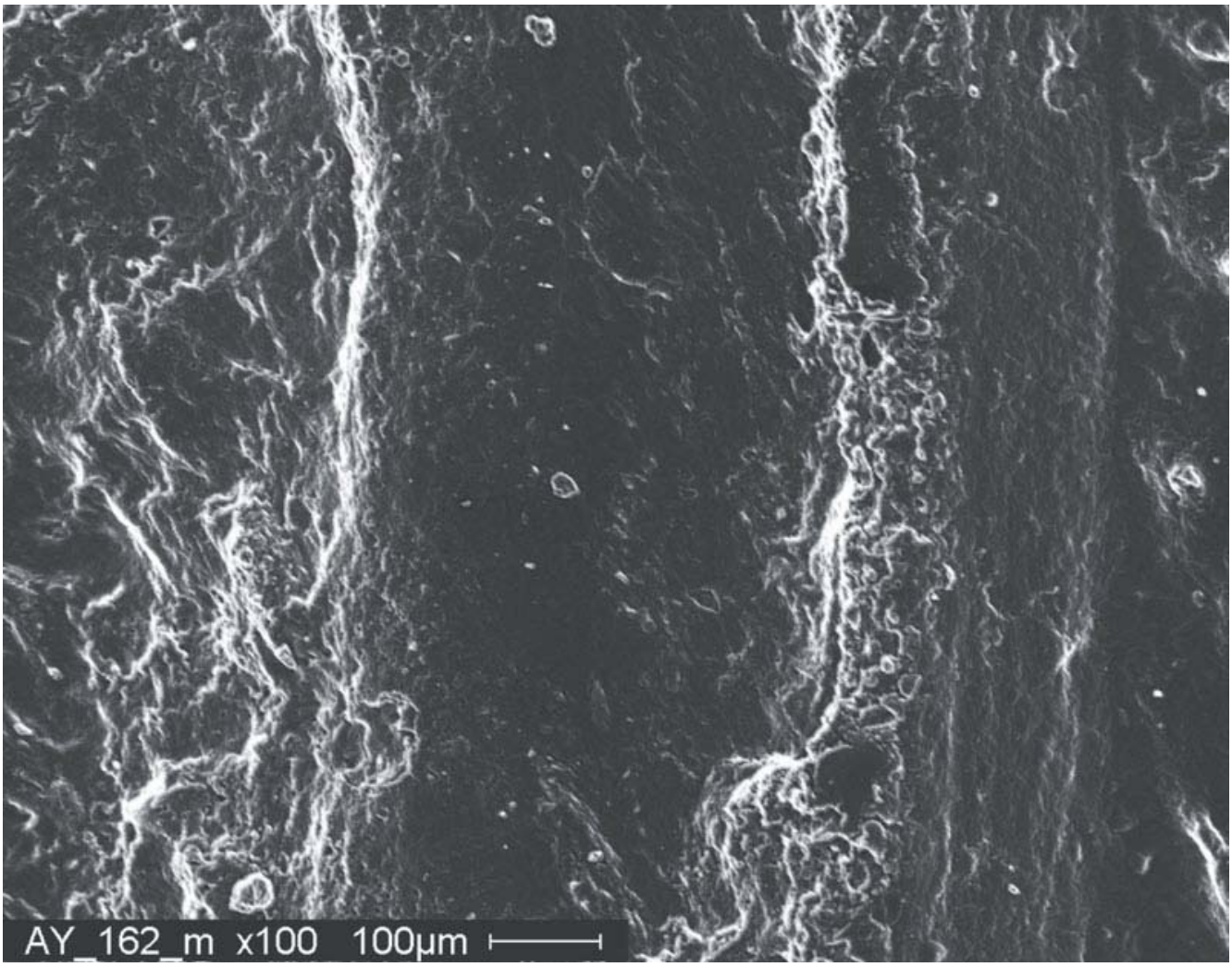

Fig. 5.5. SEM image of Atlit-Yam butchering sample (photo 162_m_100×) showing the characteristics and the profile of a groove produced by an unifacially produced unretouched chipped stone tool flake.

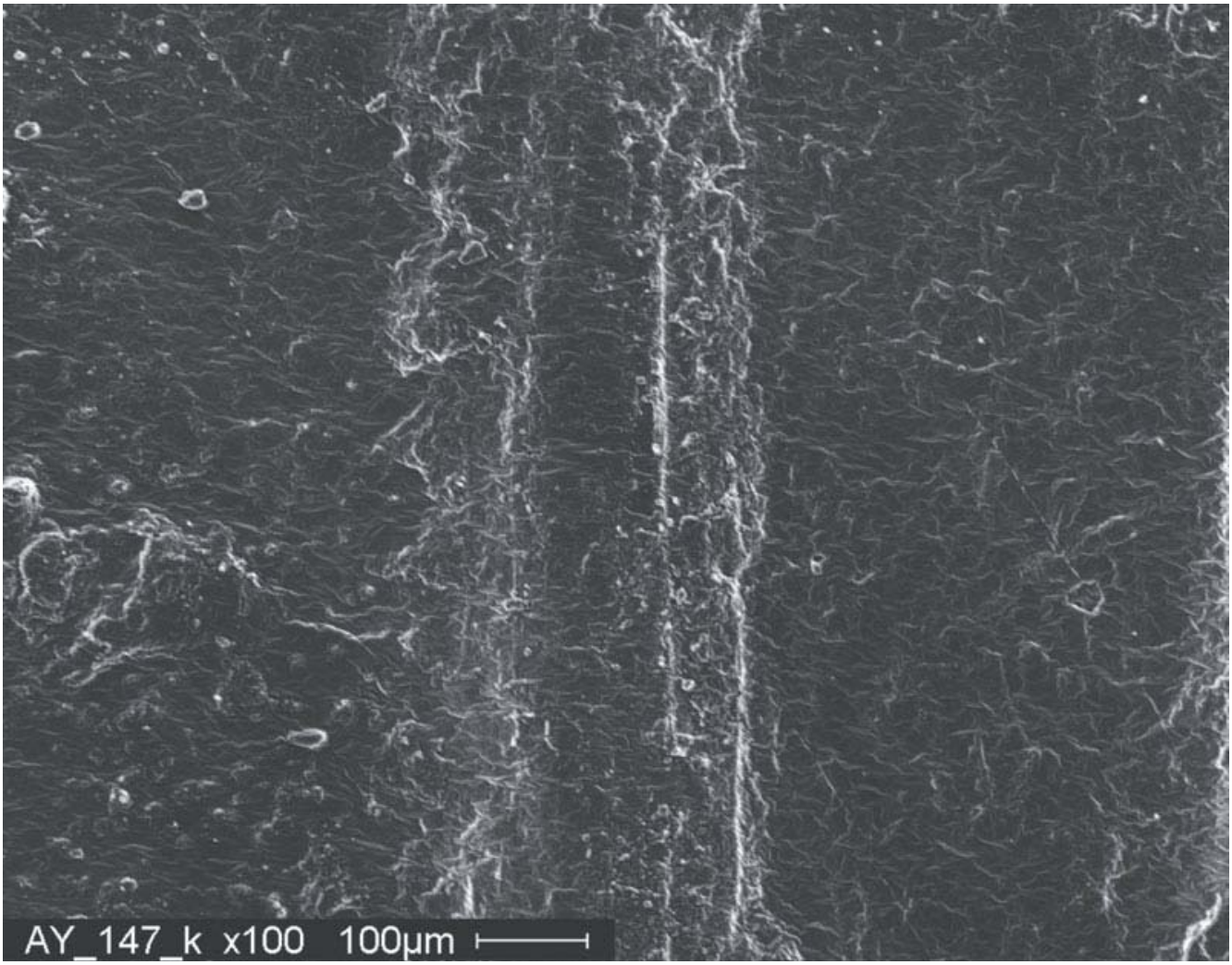

Fig. 5.6. SEM image of Atlit-Yam butchering sample 147 (photo 147_k_100×) showing the characteristics and the profile of a groove produced by an unifacially produced with unifacial retouch chipped stone tool flake.

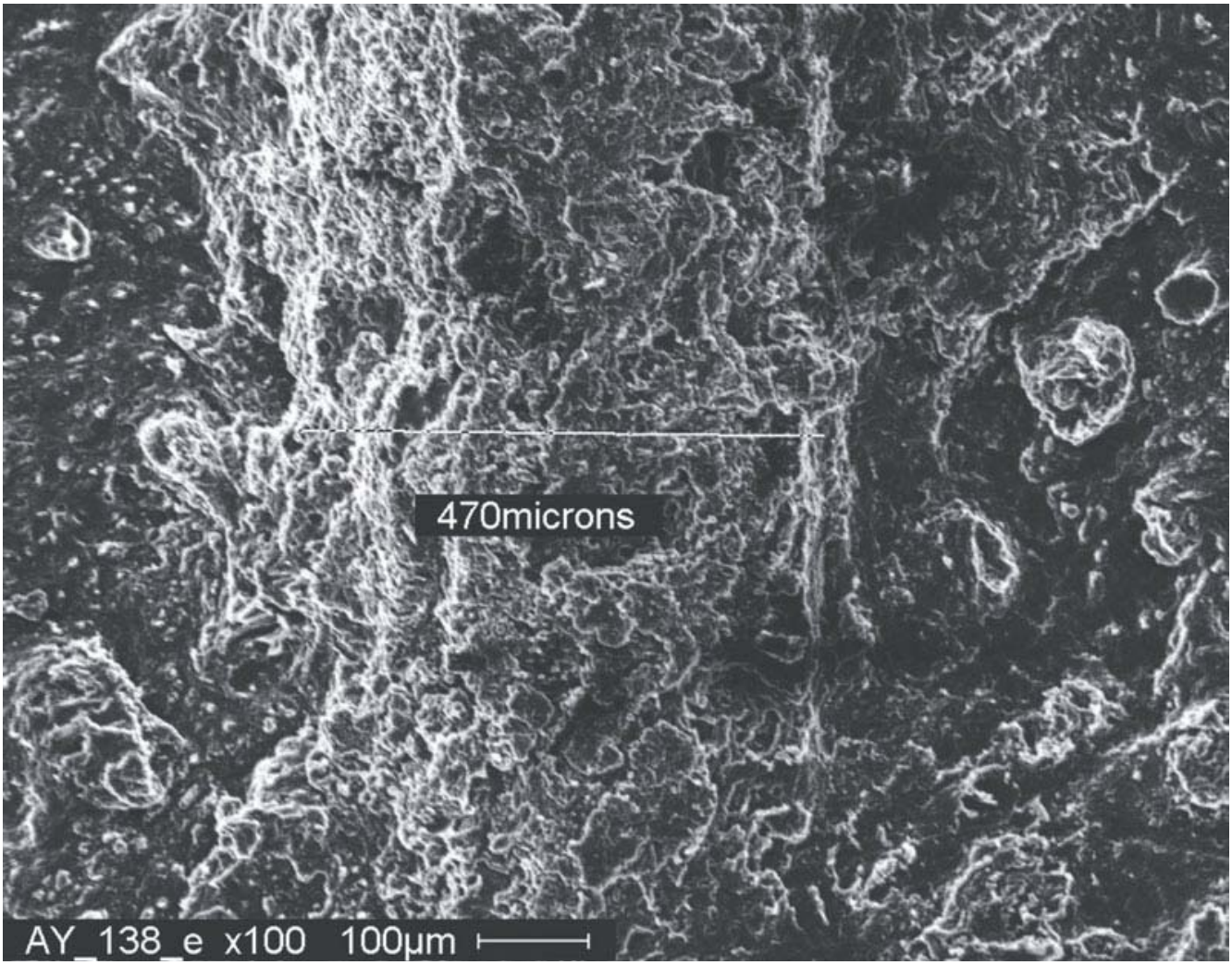

Fig. 5.7. SEM image of Atlit-Yam butchering sample 138 (photo 138_e ×100 M) showing the width of a groove made by a unifacially produced and bifacially retouched stone tool flake.

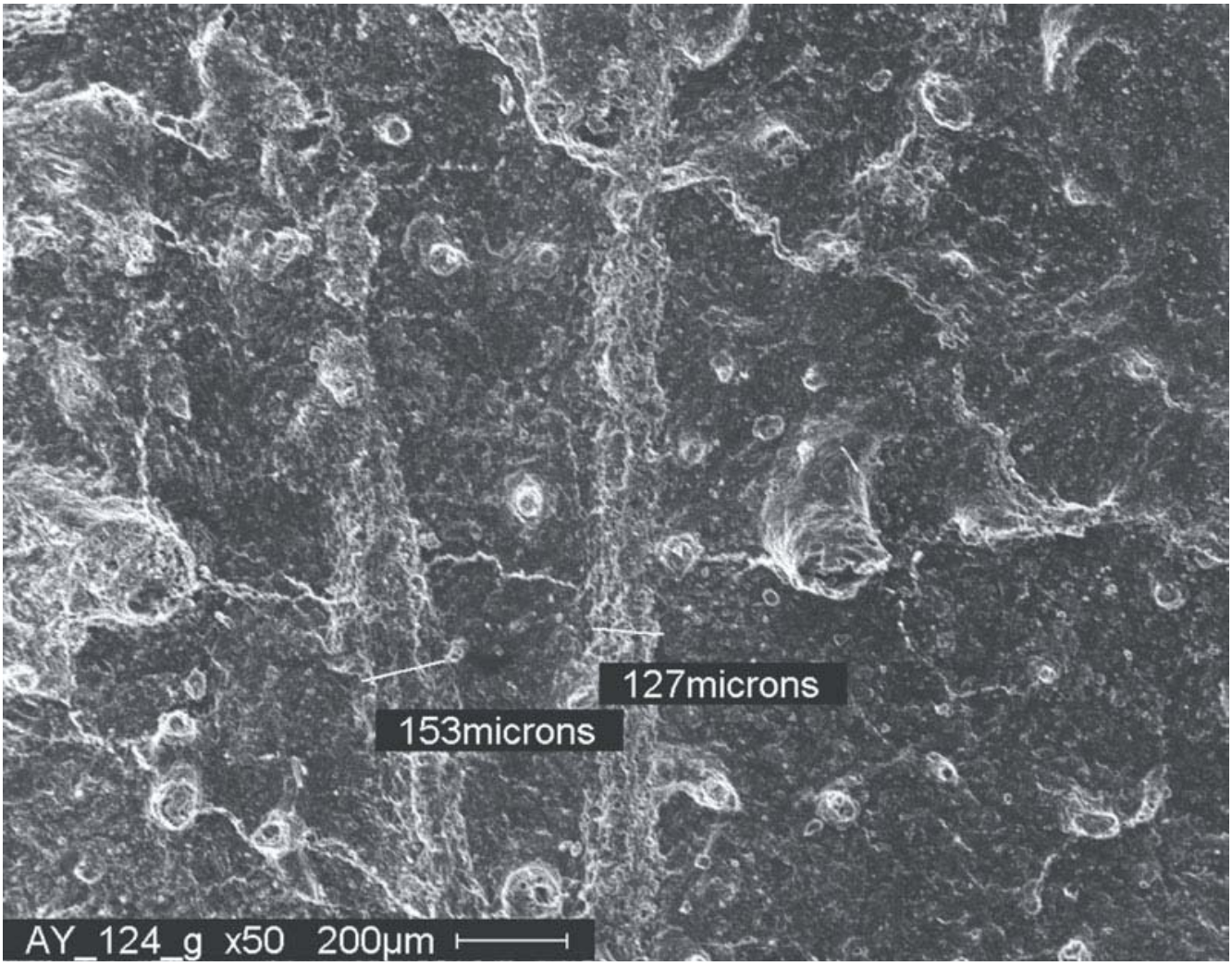

Fig. 5.8. SEM image of Atlit-Yam butchering sample 124 (photo 124_g ×50 M) showing the width of a groove made by a unifacially produced and unifacially retouched stone tool flake.

Table 5.4. Frequency distribution of butchered remains by by tool production and retouch type as measured by butchering incidence (BI).

Production type	*Retouched?*	*Sum BI*	*%*
Unifacial	No	343	91.71
	Unifacial	27	7.22
	Bifacial	4	1.07
Grand total		374	100.00

Given the absence of obsidian at the site and prevalence of flint, it is not surprising that the width of most of the grooves was not narrow, especially when compared to the widths from sites with large obsidian assemblages (such as Çatal Höyük and Göltepe: Greenfield and Marciniak in press; Greenfield

and Chaput in press). Scanning Electron Microscope (SEM) analysis allowed measurement of the width of slicing grooves (Fig. 5.8). Most measured grooves were unifacially produced, unretouched flakes and/or blades. These varied in width between 43 and 288 microns, with an average width of 122 microns. In contrast, the grooves made by bifacially retouched specimens were much wider – 199 and 500 microns, with an average of 350 microns (Fig. 5.7). Until now, none of the unifacially retouched specimens were measured in the SEM, but it is expected that they will be intermediate in width.

Butchering stage and associated tool technology

Butchering activity can be categorised as slaughtering, skinning, disarticulation, carving, and filleting stages based on location of the BI on the bone (Binford 1978, 1981). Skinning and filleting are the three most commonly represented stages of the butchering process in the sample (Table 5.5). Because of their higher frequencies, it is possible to make some general observations about the nature of the technology used in the production of tools associated with each of these butchering activities. Most of the grooves are from filleting activities (55.8% BI). This is followed by disarticulation (29.1%). The other stages are present in much smaller frequencies (skinning – 13.8%; carving and tool making – 0.52%, each; and slaughter – 29.1%).

If the issue of sample size is ignored (always a problematic assumption), there are interesting patterns evident in the distribution of the different production and retouch types by stage of butchering (Table 5.6). In all cases, unifacially produced, but unretouched flakes/blades dominate, except where frequencies are very small (*e.g.* carving). The frequency of retouched tools is interesting since it is highest for skinning marks (15%). It appears that there was preference for unretouched unifacially produced flakes/blades regardless of the type of butchering activity being conducted. This makes sense when one understands that stone tools are sharpest when freshly flaked and that is relatively easier to make new sharp flakes when raw material is abundant than it is to sharpen by retouching already dull tools.

Taxonomic differences by tool type

There does not seem to be any particular tool type associated with the butchering of particular taxa. However, there is some patterning in the data that suggests that unifacially retouched tools were preferentially used for larger taxa (Large Mammal category and *Bos* categories) with slightly higher frequency than that found on medium and small mammals: 17 out of 27 unifacially retouched BIs were found on larger taxa (Table 5.7).

Table 5.5. Frequency distribution of butchering stages by butchering incidence as measured by butchering incidence (BI).

Butchering Stage	Sum BI	%
Carving	2	0.52
Disarticulation	112	29.09
Filleting	215	55.84
Skinning	53	13.77
Slaughter	1	0.26
Tool making	2	0.52
Grand total	385	100.00

Butchering efficiency

Is there any evidence of butchering efficiency? We have chosen to use the number of slices/BI as one measure of butchering efficiency. It shows an interesting set of patterns. Of the 307 NISP from the site, the vast majority of specimens (83%) only have one incidence on them. Relatively few elements (n=52; 17%) contain more than one incidence. Out of the bones with multiple butchering incidences, most (13% of all NISP) had only two incidents. The remainder have far fewer incidences: three incidents (2%), four incidents (0.33%), five incidents (0.98%), and seven incidents (0.65%). This suggests that most bones only demonstrate the presence of one butchering-related action.

Table 5.6. Frequency distribution of butchering stages by tool type as measured by butchering incidence (BI).

Butchering Stage	Production type	?	Unifacial			Grand total
			Retouched			
	Data		No	Unifacial	Bifacial	
Carving	Sum # BI	1	1			2
	%	50.00	50.00	0.00	0.00	100
Disarticulation	Sum # BI	6	97	7	2	112
	%	5.36	86.61	6.25	1.79	100
Filleting	Sum # BI	3	198	12	2	215
	%	1.40	92.09	5.58	0.93	100
Skinning	Sum # BI	1	44	8		53
	%	1.89	83.02	15.09	0.00	100
Slaughter	Sum # BI		1			1
	%	0.00	100.00	0.00	0.00	100
Tool making	Sum # BI		2			2
	%	0.00	100.00	0.00	0.00	100
Total sum # BI		11	343	27	4	385
Total %		2.86	89.09	7.01	1.04	100

Table 5.7. Frequency distribution of butchering stage by taxon as measured by butchering incidence (BI).

Butchering stage	Disarticulation		Filleting		Skinning		Slaughter		Tool making		Total Sum BI
Taxon	Sum BI	% BI	Sum BI	% BI	Sum BI	% BI	Sum BI	% BI	Sum BI	% BI	
Bos primigenius	23	35.9	25	39.1	16	25.0		0.0		0.0	64
Bos sp.	7	28.0	13	52.0	5	20.0		0.0		0.0	25
Bos taurus	15	26.8	29	51.8	12	21.4		0.0		0.0	56
Capra hircus	7	46.7	6	40.0	2	13.3		0.0		0.0	15
Mammal, large	2	4.5	41	93.2		0.0		0.0	1	2.3	44
Mammal, medium	3	11.1	21	77.8	3	11.1		0.0		0.0	27
Ovis aries	18	41.9	12	27.9	12	27.9	1	2.3		0.0	43
Ovis/Capra	18	27.3	45	69.7	2	3.0		0.0		0.0	65
Sus scrofa dom.	9	39.1	13	56.5	1	4.3		0.0		0.0	23
Grand total	102	28.1	205	56.7	53	14.6	1	0.3	1	0.3	362

If we use the large and medium mammal category, there would appear to be a strong difference

between their BMF's (nine and five, respectively). However, when we merge all the *Bos* and all of the caprines into two large categories to ensure that there is no sample size issues, there is no obvious difference in the BMF between *Bos* and caprines (6.6 and 6.3 respectively – Table 5.8). Unfortunately, the same relationship holds true for all other large and medium sized mammal remains. There is such variability that it is possible to state the size of the animal has little to do with butchering efficiency.

Another way to view efficiency is looking at the average of # slices for each type of butchering stage (average # of slice butcher stage). It is interesting to observe a clear pattern (Table 5.9). Tool making is the largest source of butchering marks (27.5). This is followed in descending order by filleting (8.18), skinning (5.17), disarticulation (4.9), slaughter (4) and carving (2). This suggests that more care is taken in tool making and filleting to remove all soft tissue and that these activities will leave the greatest number of butchering marks. Hence, efficiency has more to do with the type of activity than the animal involved and the more careful activities are the least efficient in terms of effort (as measured by the number of strokes).

Table 5.8. Butchering efficiency (Butchering Mark Frequency – BMF) by taxon as a measure of the relationship between butchering incidence (BI) and number of slices.

Taxon	*bNISP*	*BI*	*Sum # slices*	*BI*	*Sum # slices*	*BMF*
Bos primigenius	39	64	331	64	331	5.171875
Bos sp.	21	26	175	26	175	6.7307692
Bos taurus	40	56	466	56	466	8.3214286
Bos/Cervus	1	1	22	1	22	22
Canis familiaris	2	5	20	5	20	4
Capra aegagrus	1	1	2	1	2	2
Capra hircus	12	15	97	15	97	6.4666667
Capreolus capreolus	5	6	31	6	31	5.1666667
Cervus elaphus	2	2	50	2	50	25
Cervus/Dama	1	1	4	1	4	4
Dama dama	1	2	6	2	6	3
Gazella gazella	1	1	15	1	15	15
Mammal – large	42	45	408	45	408	9.0666667
Mammal – medium	26	27	136	27	136	5.037037
Ovis aries	35	43	371	43	371	8.627907
Ovis/Capra	56	66	324	66	324	4.9090909
Sus scrofa dom.	20	23	190	23	190	8.2608696
Sus scrofa fer.	1	1	3	1	3	3
Unknown	1	1	4	1	4	4
Grand total	307	386	2655	386	2655	6.8782383

Table 5.9. Butchering efficiency as a reflection of the average of # slices for each type of butchering stage as measured by the relationship between butchering incidence (BI) and number of slices.

Butchering stage	Average # slices	Sum of BI	Sum # slices
Carving	2.00	2	4
Disarticulation	4.91	112	550
Filleting	8.19	215	1768
Skinning	5.17	53	274
Slaughter	4.00	1	4
Tool making	27.50	2	55
Grand total	6.88	385	2655

Conclusion

The results of this research have revealed a number of interesting observations. First, the frequency of butchered remains at the site is extraordinarily high (more than 40% of specimens display some evidence of butchering). This is likely due to the fact that the site was submerged shortly after the end of its period of habitation in the gradual rising of the sea level early in the Holocene. The finds were overlaid by sand, which protected them from the destructive elements of marine erosion. Most other sites from the region from earlier, contemporaneous, or later periods display much lower incidences of slicing marks. It is very likely that most of the shallow slicing marks on bones visible in the Atlit-Yam assemblage are missing from these other bone assemblages due to weathering and other taphonomic processes. How much is missing is evident from the contrast between the 40% at Atlit-Yam and the *ca.* 5% average found at terrestrial sites analysed in a comparative manner. This is probably due to the lower rate of preservation of the periosteum in the butchered assemblages. But the high preservation is not limited to the butchered assemblage alone. The entire faunal assemblage exhibits a relatively high level of preservation.

Second, there is no distinguishable relationship between tool type and butchering activity. The overwhelming numbers of grooves are created by unretouched, unifacially produced tools.

Third, butchering efficiency does not appear to have any relationship with the size of the animals. It has more to do with the stage or nature of the butchering activity. Tool making and filleting are the least efficient in the sense that they cause the most damage to the bone.

Fourth, the width of the slicing groove can also be used as an indicator of stone type. Very few

very narrow grooves were identified, which suggests that most of the butchering stone tool assemblage was local flint.

Fifth, the width of retouched specimens was wider than that of unretouched. This demonstrates that one must hold the nature of stone tool production as a constant before determining the type of stone used in the manufacturing of the groove. Retouched tool grooves were wider than grooves created by unifacially produced, unretouched tools.

Sixth, tool type analysis based upon the morphology of grooves suggests that the vast majority were made by unretouched, unifacially produced flakes. For the most part, these were ad-hoc flakes or blades used for a brief period of time and then discarded. Very little effort was put into sharpening or remodeling them with retouch. The use of unretouched flakes/blades on the majority of bones may also indicate they were a tool of convenience since they are more easily made than more elaborate tools. In all likelihood, most of the marks were made by unmodified flakes since more formal tools (*e.g*. scrapers and blades) require more maintenance to keep them in good working order. Whereas, flakes can be picked up from anywhere there is flint material, used briefly and then discarded.

In addition, two lines of evidence suggest the necessity of more intensive research in new directions. One, larger mammals may be slightly more likely to be butchered using unifacially retouched flakes. This is not certain since the data are contradictory. Two, unifacially retouched tools were slightly more likely to be used in skinning activities. It would be useful to compare the data from other sites to determine if these are typical or anomalous patterns.

The bulk of the evidence points toward the use of unifacially produced and modified flakes and/or simple blades as the tool of choice for butchering slicing activities. Flakes in particular are rarely analysed in a systematic manner that allows for their function as butchering implements to be identified. Simple unretouched flakes/blades are easier to produce and have an extremely sharp cutting edge. Hence, it is not surprising that most butchering slice marks on animal bones from Neolithic settlements such as Atlit-Yam should be made by simple unretouched, unifacially produced flakes/blades. Butchers need tools that are quick and easy to make and as sharp as possible to make their activities efficient. Observation on modern butchers at work show that they are very often sharpening their knives while working. In contrast, it is not easy to sharpen a flint blade while working. But it is very easy to produce a new new one. Therefore, it is concluded that butchering tool technology probably consisted for the most part of simple unretouched flakes due to their easy availability, abundance, ease of which they are produced and the sharpness of the cutting edge. In conclusion, it is essential that study of chipped stone tools be expanded beyond those that can be typologically identified. It must begin to include the more ubiquitous and morphologically variable flakes and simple blades, which were probably the ones used in most butchering and other activities.

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Chapter 6

Changes in "demand and supply" for mass killings of gazelles during the Holocene

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Archaeological research and ethnographic evidence demonstrated that the "desert kites" in Southwestern Asia served as hunting traps, probably from the Neolithic period to recent. Their shape and structure resemble similar traps for herd animals in other regions of the world. The reasons for the construction of these traps with a design of two leading lines of rocks (in the desert), or wooden fences in wetter regions, was to lead the frightened herd animals into the final "killing area". This hunting technique required a larger group of participants than a small task unit of mobile hunters. The motivations for such mass killing (mostly gazelle in the Syro-Arabian deserts) varied. In this paper the drive for such activity is discussed within the framework of the historically changing interactions between sedentary and mobile societies. The needs for particular supplies among farming communities from the Neolithic through Bronze Age triggered foragers to initiate mass killings of gazelles. During approximately 10,000 years the hunting technique remained the same, while the demands among farming, hunting and herding societies varied. From supplies of meat and hides, through provisions for feasts among farmers and/or tribes of foragers, and later herders of domesticated animals, the same "kites" could serve the hunters with minimal modifications, with or without leaving residues that would identify the users.

Introduction

"Desert kites" are well known as hunting devices that resulted in mass killing of different mammals in southwestern Asia. Similar structures were used in other regions of the world for the same purpose (Bar-Oz and Nadel 2013). In southwestern Asia gazelles were the prime target as reported ethnographically and demonstrated in rare cases archaeologically (*e.g*. Bar-Oz *et al*. 2011; Betts 1989, 1998; Meshel 1974). Mass killing of other species is also mentioned but the consensus among investigators is that gazelles were the preferred game (Holzer *et al*. 2010; Zeder *et al*. 2013). The geographic distribution of the "desert kites" along the semi-arid margins of the Levant can be attributed to the activities of people from different socio-economic groups. Thus, hunters could have been

members of a local tribe of foragers or a large task group of farmers who went out to hunt the gazelles for various reasons including tribal feasting. At any point in time one can view the "kites" as a device for slaughtering gazelles and exploiting their meat, bones and hides, for consumption or instead for inter-societal exchange motivated by economic and social demands. In the socially and economically intricate landscape of the Levant the products obtained through such kills could have been a component exchanged through mutualistic interactions between two societies. Mass killing of gazelles allowed the practitioners to satisfy the "demands" of the clients whether they were their own tribal members or "others". It would be obvious, given the history of the region since the Neolithic period, that these supplies were explicitly expected by farmer-herders who, instead of slaughtering their own goats and sheep (the walking larder or their valued capital), would prefer to get meat, bones and hides from their neighbors, the foragers. It is this aspect of changing demands through time that I will examine in the following pages.

The archaeological markers of the Neolithic Revolution in the Levant are best known from the early villages established by those foragers who became the founders of the fully-fledged agro-pastoral societies (*e.g*. Simmons 2007). The change, in evolutionary time scale, was fast, a sort of "punctuated equilibrium", but in the reality of human life it was a slow transition from foraging to farming, and the successes were punctuated by temporary failures as well as constant changing of inter- and intra-societal struggles for stable social structure. This revolutionary chain of events began when the flexible interaction spheres of Terminal Pleistocene Levantine foragers gradually broke down. The tipping point of this process occurred when several groups whose traditional subsistence was based on hunting and gathering became sedentary or semi-sedentary, a state favored by particular social entities (tribes?). Examples of this change are evident in the southern Levant with the formation of the Natufian culture (*ca*. 15/14.5 kya cal BP through *ca*. 11,700/500 kya cal BP), and a similar cluster of sites in the Tigris River basin, larger in size when compared to the Natufian communities, which appeared from *ca*. 12,000 cal BP through 11,200 cal BP (Bar-Yosef 2014).

Sedentary people, more than mobile foragers, became fully aware of their territorial rights, especially as they adopted the cultivation of plants and tending goats, sheep, cattle and pigs. This trajectory, which resulted in the eventual domestication of plants and animals, as the majority of researchers currently suggest, lasted several millennia under fluctuating environmental conditions from *ca*. 11,700/11,500 cal BP until *ca*. 10,500/200. The establishment of the Neolithic farming communities culminated during the ensuing millennia until about 8,4/200 cal BP. The entire period is known in the Levant as the Early Neolithic or in the local jargon as PPNA and PPNB (abbreviation of Pre-Pottery Neolithic period A and B; *e.g*. Simmons 2007). During approximately three and a half millennia the entire process dramatically changed the social fabric of the Levant with ensuing impacts on the landscape of both the western and eastern wings of the Fertile Crescent. In the course of these millennia the separation between the farmer-herders, who continued to hunt, and those who essentially survived on hunting, gradually evolved toward the formation of two kinds of societies, namely, farmers in areas suitable for cultivation and foragers in the more marginal habitats, whether forested, as in the northern Levant or semi-arid as in the Syro-Arabian and Sinai deserts. However, boundaries were flexible and intermarriage was probably possible, and even rivalries among the new clusters of families or clans within the villages could have ended up by cultivators quitting and becoming foragers again. Examples are known from other regions of the world and are backed by genetic analysis (*e.g*. Oota *et*

al. 2005).

The landscape of the Levant, known for its ecological diversity, was thus an arena for the formation of a set of varied cultures representing demographic units that I prefer to see as tribes following the definitions based on ethnographic studies (*e.g*. Birdsell 1968, 1975). The climatic pattern of the early Holocene afforded more or less stable conditions for the slow development of cultivation, sufficient time for the "Domestication syndrome" among the plants, and also supported continuous hunting by both farmers and foragers. Although we do not have all the required evidence, foragers in the semi-arid zone could survive on hunting and low levels of food production. The latter aspect is supported by ethnographic information concerning particular Bedouin tribes whose economy is historically known. In the semi-arid loess exposures in the dune fields of Northern Sinai, Bedouin sowed barley during the fall and came back in early summer for the harvest, keeping portions of their yields along with their tools (plows, sickles) near the fields in underground storage pits (pers. obs.). A similar phenomenon has been recorded in 'Uvda Valley in the southern Negev (Avner 2006, 2007). However, this strategy could easily fail during drought years when the population in the marginal belt was forced to get their carbohydrates from the villagers either by exchange or by successive raids. An exceptional case are the Solluba Bedouin (Betts 1987) who in recent times survives as hunters without herding goats or camels and were providers of products from the semi-arid region to the settled villages.

In sum, during the course of 3,000–3,500 years (or about 150–175 human generations of 20 years each), the socio-economic changes and the ensuing adaptations of the old cosmologies to the new social regimes within the Fertile Crescent laid the foundations for the Ancient Near Eastern civilizations. Contemporaneously, as time passed, these developments allowed for the evolution of mutualistic interactions between farmers and foragers, and later between farmer-herders and hunters and finally between farmers and herders but undoubtedly fluctuated between friendly and hostile relationships as described elsewhere (*e.g*. Bar-Yosef 2001, 2010).

Mutualistic interactions between the two societies were probably in constant flux. The relations were either amicable, which may have led to intermarriage, perhaps with forager women marrying into farming communities as suggested by ethnographic investigations (*i.e*. hypergyny; see Bailey 1988; Dickemann 1979), or hostile, leading to acts of violence, raids and fighting (Spielmann 1986). Given the ecological conditions, complex foraging societies in the Levant were first established during the first millennia of the Holocene as villagers in the Tigris River basin or survived as mobile groups across the Syro-Arabian and Sinai deserts (Fig. 6.1). Many of these groups played a role that is yet not fully studied and understood. Their interactions with farming societies were through exchange or barter that could have taken place during late spring, summer and early fall. The non-perishable goods brought to farming communities included products such as chlorite bowls, hard rocks such as igneous, metamorphic or special types of limestone from the Syro-Arabian desert, the Negev and Sinai, and marine shells from the Red Sea. In addition we need to test the hypothesis that foragers were among the traders who brought the obsidian and possibly cinnabar from Anatolia as well as chlorite bowls from the Tigris basin to the Levant. To this short list we should add the perishable products, namely animal tissues and hides, medicinal plants, perhaps even incense plants from southern Arabia. In return, hunter-gatherers and later herders could get grain (D. E. Bar-Yosef 1997), perhaps animals (goats?), and Mediterranean sea-shells, and textiles in later Neolithic period known as Pottery Neolithic, as well

as the Chalcolithic.

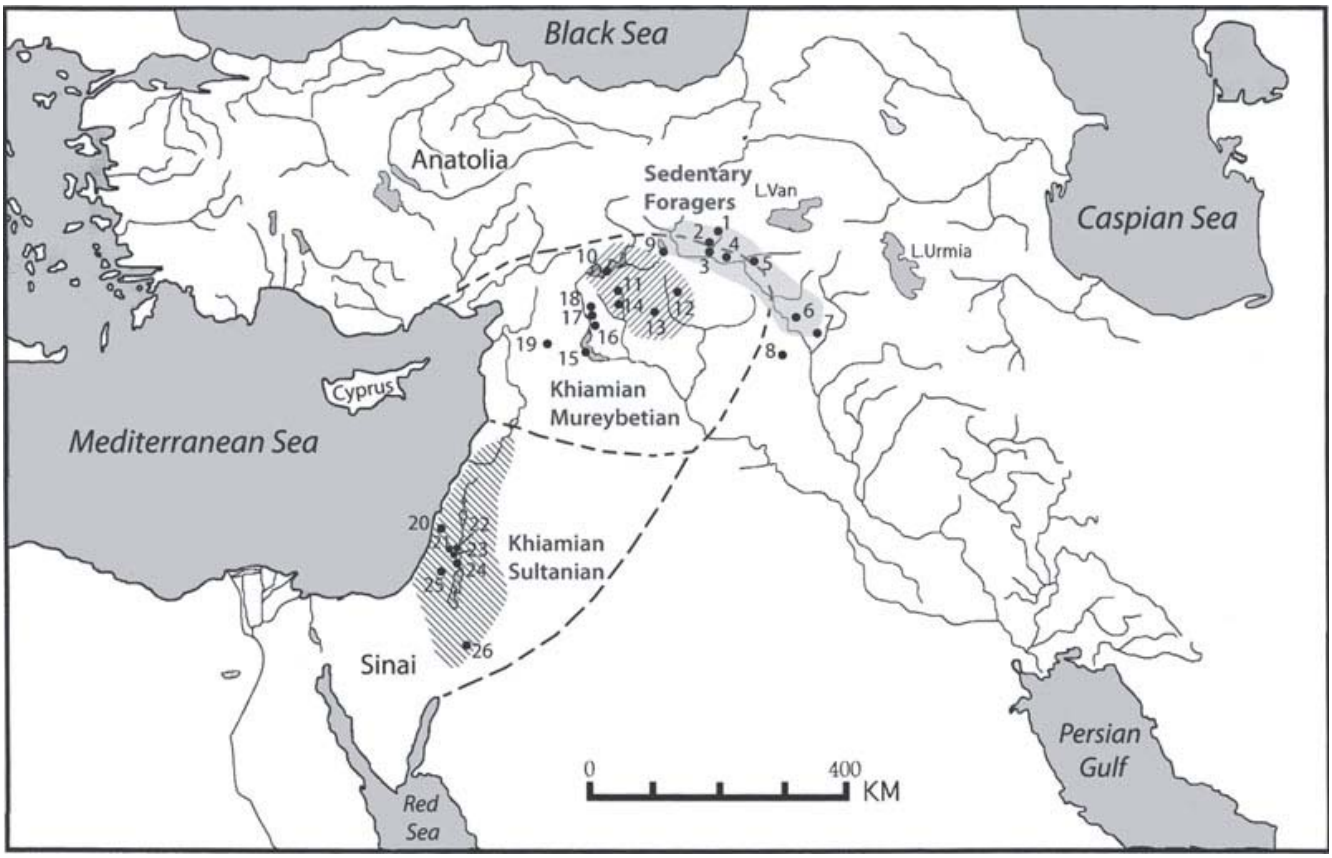

Fig. 6.1. Distribution of socio-economic and cultural entities during the first two millennia of the Holocene.

The "Desert kites" are currently the best physical markers of farmer-forager interactions (Bar-Yosef 1986; Betts 1989, 1998a, b; Betts and Helms 1986; Meshel 1974; Nadel *et al*. 2010; Zeder *et al*. 2013). They were probably first laid out during the PPNB by foragers in order to hunt mainly gazelles. Employing this technique must mean that there was a demand for meat, hides and horns. The demands grew up when Late PPNB sites, such as the "mega-sites" in the Jordanian plateau marked the expansion of earlier phases and clearly signify a rapid population growth. Several sites of 10–12 ha in size (Ain Ghazal, Wadi Shu'eib, Basta, es-Sifiyeh) accommodated a population of 1,200–1,800 people (based on 100–150 people per hectare). By comparison, earlier villages of the PPNA period rarely reached this size. The larger ones of 2.5–3.5 ha were populated by 250–500 people that allowed for almost one biologically viable unit to co-share habitation in the same settlement (Bar-Yosef and Belfer-Cohen 1989). The domestication of goats, sheep, cattle and pigs was achieved during the PPNB replacing the hunted game that dominated the faunal assemblages of the earlier Natufian and PPNA sites. Thus, the quantity of bones of hunted game in the PPNB farming villages decreased considerably when the domesticated species attained 80–90% of the fauna. If wild game was needed for ritual or other reasons, villagers had the option of hunting farther away (entering territories of the "others") or negotiating with the foragers for a "supply package" (*e.g*. meat, hides, hard rocks, Red Sea shells and more). Acquiring large quantities of these supplies could be the reason for the first construction of "desert kites".

At this point we should note that undoubtedly the main issue is "since when have 'kites' been

built"? All researchers who have studied them in Jordan, Syria and Israel have faced the same question. The answer, obviously, should come from excavated "kites" but only a few in Jordan and Israel have been the targets of systematic excavations. Betts reported the results from Dhuweila (Betts *et al*. 1998), attributing the "kites" at that place to the Late PPNB, although based on the animal bones these structures could have been built somewhat earlier (Martin 1998, 2000). Similar conclusions were offered for the mass killings of the gazelles recorded in the PPNB deposits in Tell Abu Hureyra (Legge and Rowley-Conwy 1987). However, in Jawa, Betts and Helms recognized that "kites" could be dated later, in the Chalcolithic-Bronze Age.

In Syria, Echallier and Braemer (1995) concluded that the "kites" in their study area (of *ca*. 500 sq km) were laid out in two different directions (east and west) and must date to the Chalcolithic–Bronze Age period. They also proposed the hypothesis that the "kites" might be some sort of corral erected by pastoral societies. This was persuasively negated by Rosen and Pervolotsky (1998). In addition, the dating suggested by the former authors was based on tentative correlations with the closest mound but not on direct dating.

In Israel, the excavated "kites" in the southern Negev have been dated to *ca*. 5,300–3,200 cal BP by 14C and IRSL (*e.g*. Holzer *et al*. 2010; Nadel *et al*. 2010). The additional case of a major slaughter of gazelles in one event at Tel Kurran supports these dates (Bar-Oz *et al*. 2011; Zeder *et al*. 2013). However, without further excavations within the main geographic concentrations of "kites" (Kennedy 2012), it is premature to accept that the Late Chalcolithic–Bronze Age (fourth through the end of the second millennia cal BC or *ca*. 6,000 to 3,000 cal BP) is the period when all "desert kites" were constructed and used. We should note that the reasons for mass killing of gazelles could have been in place since PPNB times and that according to field observations and air-photo evidence, not all were built at the same time, as shown in numerous cases in Jordan and Syria by their stratified positions. Therefore, supportive evidence for a longer history of the "kites" can be derived from their distribution in the eastern fringes of the Levant. The largest concentration is in Jordan in the area called Badiyat esh-Sham (Kennedy 2012). Thus, an additional question should be "why does this area have the largest concentration of 'kites'?" Does it indicate that the availability and predictability of natural resources in this area attracted particularly large herds of gazelles?

In considering PPNB interactions between farmers and foragers, I note that in one of the Jordanian sites dated to this period (Garrard *et al*. 1994: fig. 3) a rectangular house was uncovered within a foragers' campsite of rounded dwellings that were arranged in a semi-circle. This different type of dwelling attached to the edge of the camp could be interpreted as the "merchant's temporary home". Indeed, the boundaries between farmer-herders and foragers in the semi-arid or mountain regions during the PPNB were sometimes fluid (Figs 6.2 and 6.3).

After the collapse of the PPNB societies due to the so-called "8,200 cal BP Cold Event", now better recorded in the Levant and adjacent regions (Berger and Gulaine 2009; van der Plicht *et al*. 2011; Weninger *et al*. 2009), the economic dichotomy between farmer-herders and the emergent pastoral nomads who continued to hunt became more clearly established in the following millennia (eighth through recent). Members of both economic regimes continued to hunt locally and conduct exchange relations that reached over large distances.

The "kites" in the 'Araba Valley in the Negev (Holzer *et al*. 2010; Nadel *et al*. 2010) are located within a regional context in which farming has been conducted in the nearby 'Uvda Valley from Late

Neolithic to recent times (Avner 2006, 2007), and thus could mark the activities of locals when they conducted mass killings. The radiometric dates obtained from the “kites” in the ‘Araba Valley are spread from the fifth to third millennium cal BP, but as a series of seemingly isolated events. These observations should warn us that periods in the semi-arid area of the eastern Levant when there appears to be no evidence for the use of kites may simply reflect the absence of suitable dating material, or events that left behind insufficient evidence for their recognition. Thus, the initial phase of the “kites” could be as early as when mass killings were needed in PPNB time. Similarly, evidence for their use in the early Chalcolithic is not available. It seems that more caution is required before the verdict on the age of the “kites” is signed. Moreover, the fact that kites appear to have been used in different ways leaves unanswered the question of what their purpose was.

Fig. 6.2. The zone of active interactions between farming communities and their neighbouring foragers.

The mass killing of Persian gazelles *(Gazella subgutturosa)* evidenced in Tell Kuran on the bank

of the Khabur river, a tributary of the Euphrates, was dated to *ca*. 5,500/300 cal BP (or 3,700/500 cal BC). It was a bone deposit resulting from a single event (Bar-Oz *et al*. 2011). A few bones of other mammals may have been intrusive (cattle, equids, goat/sheep). Although no "kite" was found in the proximity of the site, 10 km away, on the Hemma plateau, Van Berg and his associates (2004) found several kites that they [?] considered contemporary with the fourth to third millennia BC deposits in Tell Kuran.

In order to understand the social context of this major butchery event we need to remember that during the sixth through third millennia BC the region called Upper Mesopotamia was in the throes of the emergence of chiefdoms evolving later into city-states. One aspect rarely discussed in the history of this region is the issue of river transportation. Today's situation of the current Khabur river does not indicate its importance in the past, as the same situation rules the Euphrates river which is interrupted by dams. Therefore, before suggesting a new interpretation to the Tel Kuran assemblage a brief overview of river transportation in the northern Levant and Mesopotamia is in order.

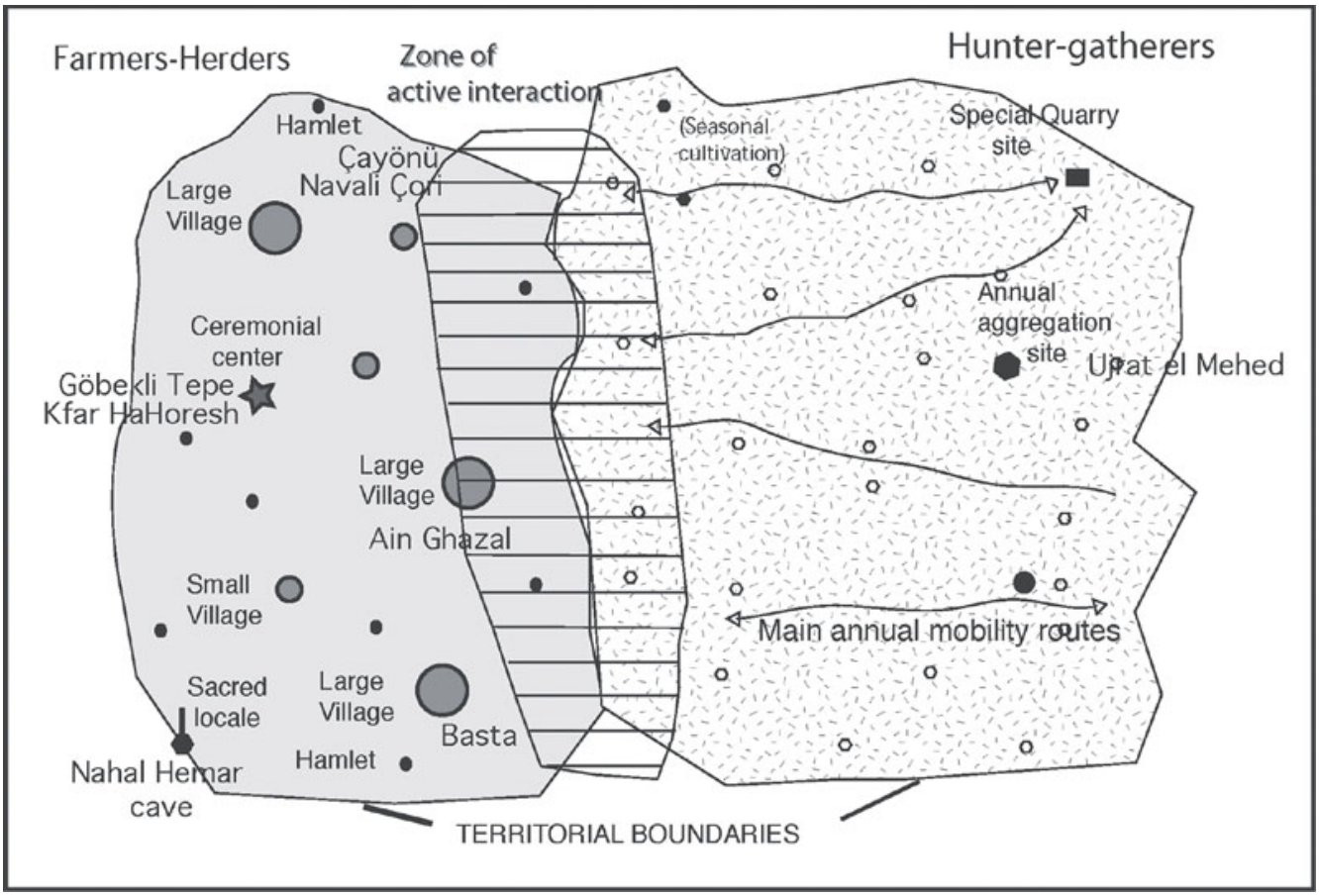

Fig. 6.3. Schematic map of interactions between foragers of the semi-arid environments and farming communities during the PPNB.

In the Fertile Crescent, the Euphrates and Tigris Rivers served for transport over many millennia. Although the spring melting of snow in the mountains of eastern Turkey – the main source region for the waters of the two rivers—caused rapid flow and sometimes flooding and resulted in major alluviation events within the Mesopotamian basin, the rivers nonetheless served as major highways. Rowing in small boats made of reeds and covered with the hides of hunted animals (or later with those of domesticated species) from the Taurus foothills to southern Mesopotamia and the Persian Gulf

would not take more than a month or two. Similarly, simple wooden rafts placed over several animal hides filled with air (known as "skin floats") and memorialized in an Assyrian palatial bas-relief, were still in use during the nineteenth century (Hornell 1942; McGrail 2001; Fig. 6.4).

The making of the inflated skins, whether of goats or cattle, are described by Hornell (1942: 37) as follows:

> "Before commencing to skin the body of a goat, the head, feet and part of the tail are cut off; this enables an expert worker to detach the skin from the body by working backwards from the neck without having to make a slit along the abdomen. When freed, the skin is turned inside out after all apertures have been sewn, or securely tied and closed with cord or with hide thongs, except the cut end of one foreleg. When required for use the skin is blown out tight through the one leg left open, which is then closed with a lashing of cord."

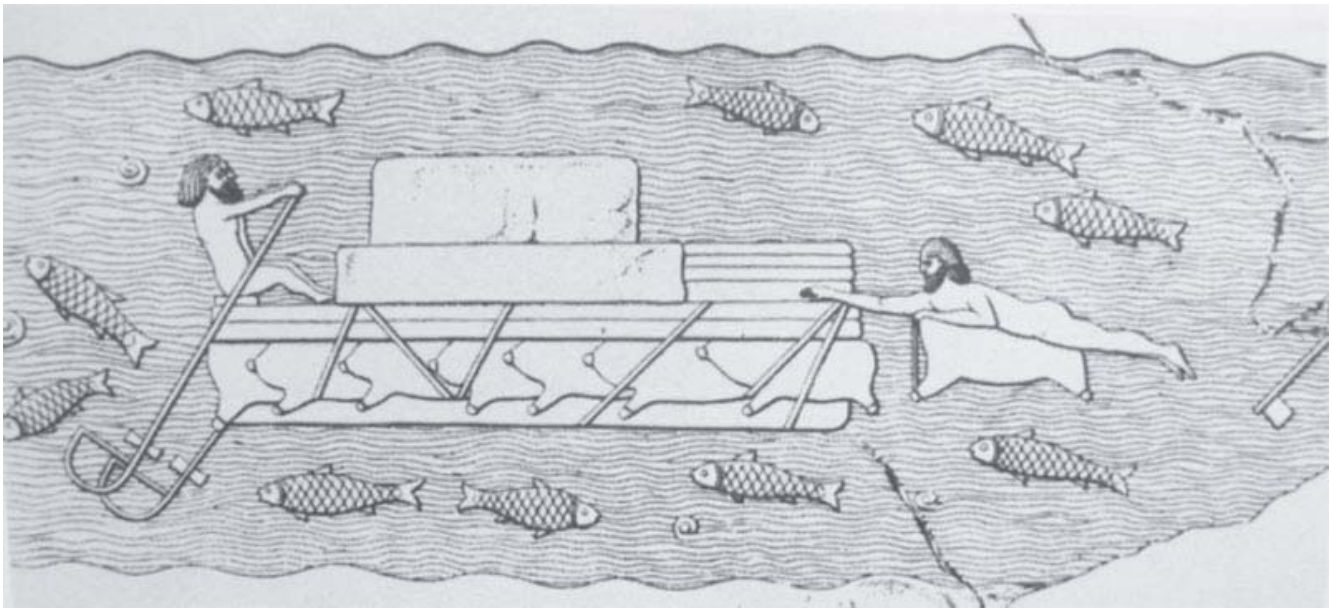

Fig. 6.4. Assyrian bas-relief showing the use of skin-floats for individuals and raft (Casson 1971: Illustration 1).

Similar goats' hides were employed by the Bakhtiyari for river crossings and recorded in the film *Grass* that was made in 1925 (Schoedsak 1983). Other ethnographic examples can be cited (*e.g.* Hornell 1942; McGrail 2000) but suffice is to mention that river transport was faster than other means (until the domestication of horses that pulled chariots). The people who lived in various parts of southwestern Asia since the Terminal Pleistocene and during the Holocene were responsible for seafaring by building boats and colonizing Cyprus, many islands in the Aegean Sea and ranging farther into the western Mediterranean. Thus, employing waterways for the growing economies, exchange, trade, commerce and territorial control was among the ongoing agendas along the Euphrates and the Tigris. If we employ the seasonal movements of the Bakhtiyari herds, crossing rivers was an issue and using personal floats (made from one animal hide) and wooden rafts over several skin-floats, were common techniques that became an element of the traditional skills of the people in this region. Thus, the case of Tell Kuran may represent the demands of the community or the elite for a large number of skin-floats and this would explain the mass killings of the gazelles exposed in the excavations.

I therefore suggest that we should adopt a multi-viewpoint approach when we examine the use of

"desert kites". It was perhaps not the meat that was the main reason for the mass killing of the gazelles in the Tell Kuran case but the need to produce a large number of skin-floats for transport. It therefore brings us to a point already raised in the commentary of Speth (2013) who, from a view point of Paleolithic research, stated that:

> "the social context of the hunt can also play an important role in what foragers pursue, when they do it, and the way they go about it. Thus, acquiring prestige, engaging in costly signaling, establishing or maintaining political alliances, fulfilling bride price or bride service obligations, or making offerings at funerals may all provide important motivations for hunting". (Speth 2013: 182)

We should now add to this list the requirements of later, historical populations of the Ancient Near East and suggest that "desert kites" are only a device created for mass hunting, but the purpose of this act varies according to varied needs in different times that should be investigated and dated on a case-by-case basis while taking into account the entire social landscape of the Levant.

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Chapter 7

Halaf Period Animal Remains from Tell Aqab, Northeastern Syria

László Bartosiewicz

A small assemblage (NISP=3,217) of 5th millennium BC Halaf and subsequent Ubaid Period animal bones and molluscan remains was recovered during the 1975 and 1976 field seasons at the site of Tell Aqab (Jezirah province, northeastern Syria) some 100 km west of the Tigris River forming the current border between Turkey and Syria. The ca. 9.5 m high mound is located alongside a small seasonal stream that forms part of the Wadi Dara drainage system. Excavations were carried out by a University of Edinburgh team following a survey in the Khabur River floodplain. The purpose of excavations at the time was to clarify regional patterning in ceramic assemblages during the periods for which Tell Aqab had well-stratified layers, especially the Middle Halaf Period.

Unsurprisingly, the poorly preserved faunal material was dominated by the bone fragments of small ruminants, evidently sheep and goat. Remains of cattle and pigs were also recovered. Hunting was indicated by the sporadically occurring remains of wild ass and gazelle, possibly also contributing to the heavily fragmented small ruminant remains. High fragmentation precluded the detailed metric analysis of bones. Meanwhile, in addition to the number of identifiable specimens (NISP) individual bone weights were taken in an effort to better appraise the dietary contributions of the species identified. Adding faunal information to this archaeological work contributes yet another data point to the map of prehistoric animal exploitation in the Fertile Crescent.

Introduction

In the northern periphery of Mesopotamia, the transition between the Late Neolithic and the beginning of the Chalcolithic is represented by the Halaf and Ubaid periods. The Halaf culture developed from Neolithic III without any visible disruption. Its Middle (*ca*. 5,800–5,400 BC) and Late (*ca*. 5,400–5,100 BC; Liverani 2013:48) phases are best represented by the material under discussion here. Toward the end of the 6th millennium BC, the territorial expansion of the so-called Halaf painted ceramic ware began between present-day western Syria and eastern Iraq, including the northern Jezirah region

between the upper reaches of the Euphrates and Tigris Rivers. Around 5,300 BC, the second half of the Ubaid period, its material culture (a popular, technologically advanced form of painted ware) first reached other regions including Upper Mesopotamia and Anatolia. The Halaf period appears to have largely ended before 5,500/5,400 cal BC and the Ubaid begins after 5,200 cal BC. By 4,500–4,000 BC the Ubaid culture spread into northern Mesopotamia, replacing eventually the Halaf culture (Carter and Graham 2010). Tell Aqab is one of the few known sites whose find material connects the Halaf and Ubaid periods although chronological details on the site are still to be published (Campbell and Fletcher 2010). It seems that Halaf-Ubaid Transitional material culture spanned the time period between the Neolithic and Chalcolithic in the region (Watkins and Campbell 1987).

The prehistoric settlement of Tell Aqab is found in present-day Jezirah Province of northeast Syria. The site itself is located in the upper Khabur River Valley, 6 km south or the modern town of Amuda near the border with Turkey. The mound is one of the sites within the so-called Khabur triangle, the fertile floodplain deposited by the river and its web of tributaries (Fig. 7.1). It was excavated by a University of Edinburgh team directed by T. Watkins and T. E. Davidson in 1975 and 1976 (Davidson and Watkins 1981). The principal purpose of excavations was to clarify regional ceramic distributions during the periods for which the site had reliable stratigraphic data.

The Halaf pottery style was widely spread for approximately a millennium in this region (Watkins and Campbell 1987: 451–453). Tell Aqab was not abandoned after the Halaf period but through a brief transition life continued into the Ubaid period (*ca*. 4,500–3,800 BCE; Davidson 1981: 66) the last known occupation of the tell proper. AMS radiocarbon measurements were carried out at the University of Arizona, Tucson on samples of short-lived cereal grain. As of today, a Middle Halaf (Aqab 212, AA-30498: 5,579–5,350 BC) and an very early Ubaid (Aqab T4.19, AA-30506: 5,266–4,995 BC) date have been published from the site within the framework of the Khabur regional chronology (Hole 2001: 73). These 2-sigma range estimates fall in line with several dates obtained for closely related sites in the vicinity of Tell Aqab as detailed by Hole (2001).

Natural environment

Tell Aqab is located *c*. 60 km northeast of the type site of Tell Halaf (Oppenheim 1931) along a seasonal water course that belongs to the Wadi Dara drainage system. Toward the north the southeastern Taurus Mountain range is within sight of the settlement mound. In the south, the highest elevations in the alluvial plain of Jezirah are the hills of Jebel Abd al-'Aziz (west, 920 m asl) and Jebel Sinjar (east, 1,480 m asl), separated by the Khabur River turning south as it exits toward the steppe.

Today the site falls within the 400 mm (but almost onto the 450 mm) precipitation isohyet where dryland farming (without irrigation) could still be comfortably practiced. Notably, south of the 250 mm isohyet dry farming becomes increasingly risky (Zeder 1994: 99). The upper Khabur Valley was a focal region of Halaf period sedentary agriculture confined to regions of sufficient rainfall. Halaf settlements have been thought of as village-based societies pursuing a combination of dry-farming and pastoral economy (Akkermanns 1990). Similarly to the majority of Halaf sites, Tell Aqab is thus located in the dry periphery of the Mediterranean at the northern margin of tropical deserts characterized by winter rainfall and xeric Mediterranean forest-steppe vegetation. Mediterranean brown soil and alluvium surround the site in an at least 5 km radius (McCorriston 1992: 317, fig. 2/B). Dry-farming could be productively pursued on this type of rich steppe brown soil, although the topsoil may recently have

somewhat changed through deforestation/erosion. Large Neolithic settlements topped with Halaf components (*e.g.* Tell Halula, levels 36 and 37: Estebaranz *et al*. 2007: 65; and Tell Sabi Abyad, levels 1–3: Cavallo 2000) add emphasis to the historical fact that domestic plants and animals had been well-established in the area; by the time of the Halaf period food producing economies had been flourishing across the Fertile Crescent for millennia.

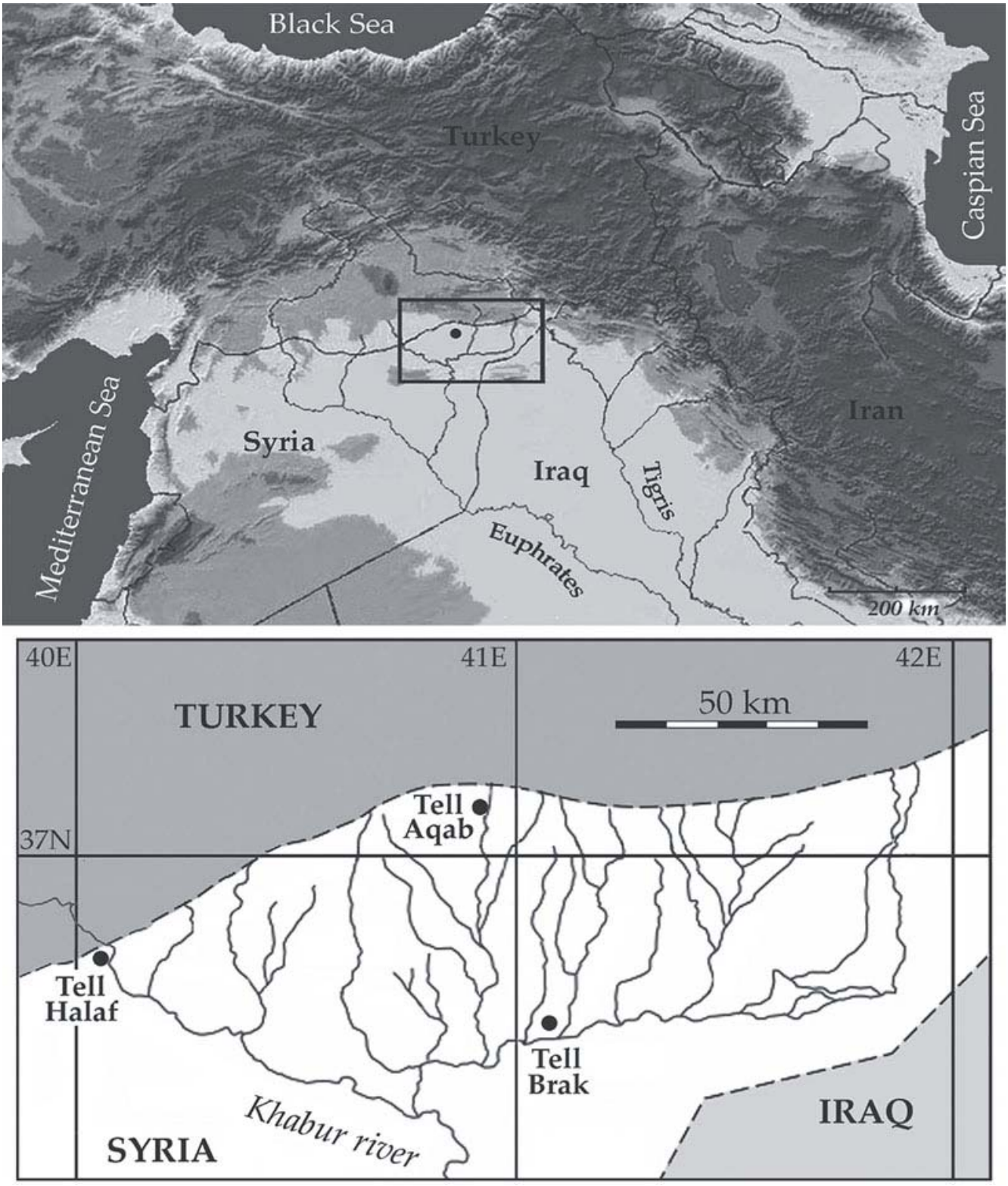

Fig. 7.1. The location of Tell Aqab (dot) in relation to the Fertile Crescent (top) and the Khabur triangle.

Archaeobotanical research at Tell Aqab (McCorriston 1992: 321, table 1) yielded relatively scarce evidence of wood consisting of ash (*Fraxinus* sp.) and juniper (*Juniperus* sp.) remains. Among weeds annual beard grass (*Polypogon* sp.), cow soapwort (*Vaccaria pyramidata* Medik.), catchfly (*Silene* sp.), milkvetch (*Astragalus* sp.) and prickly scorpion's tail (*Scorpiurus muricatus* L.) could be identified. Several genera identified represent the legume family (Fabaceae), including *Trigonella* (related to domestic fenugreek), *Medicago*, *Trifolium*, and *Lathyrus*. Although the domestic status of these dicotyledonous weeds could not be confirmed, several members of the family have been widely used as forage.

The distributions of wild progenitors to Near Eastern cereals and legumes overlap only here, in the area of southeastern Turkey and northern Syria (Lev-Yadun *et al*. 2000). It is therefore unsurprising that samples of Tell Aqab contained grain, chaff, rachis and glume fragments of emmer wheat (*Triticum dicoccum* Schrank.) and two row barley (*Hordeum vulgare* Linné). Lentils (*Lens culinaris* Medik.), bitter vetch (*Vicia ervilia* [Linné] Wild.) and flax seed (*Linum usitatissimum* Linné) were also encountered (McCorriston 1992: 321, table 1).

Material and methods

The steep northern slope of Tell Aqab was excavated to reveal its stratigraphy. Trenches 1 and 2 extending 10 m down were 4 m wide. Trench 3 was opened on the flat skirt of the mound measuring 3 × 4 m, down to the clay subsoil at *ca*. 2.3 m below the 1976 level of the plain. Meanwhile Trench 4 on the south slope exposed Ubaid period strata (Davidson and Watkins 1981: 4, fig. 1). Standard methods of recovery and recording were employed for all classes of archaeological remains. Both dry and wet sieving were systematically used. Excavated soil was screened using sieves with 1 cm mesh size. Plant remains, small bones and artefacts from selected deposits were recovered using a modified Cambridge Mark III froth flotation apparatus (Davidson and Watkins 1981: 4). Approximately 13 kg of the animal remains thus retrieved are the subject to this study, and are kept in the osteological collections of Edinburgh University. In spite of fine recovery methods no fish remains were found in the sample discussed in this study, although finds of riverine mussel indicate the exploitation of aquatic habitats.

The basic analysis of the material was made in terms of the number of identifiable specimens (NISP). Given the chronological complexity and limited size of the assemblage the calculation of minimum numbers of individuals (MNI) would have made little sense. Since, however, bone numbers are massively influenced by fragmentation, NISP values were complemented by individual bone weights. In prehistoric find materials of largely uniform sub-fossilization bone weights are a better proxy to the relative quantity of meat gained from various animals than fragment numbers (Bartosiewicz 2007: 288–289).

The animal remains were heavily fragmented, but their surface preservation was very good. High ratios of non-identifiable bones occurred only in the two smallest (Early Halaf and Ubaid) sub-assemblages in which each individual fragment represents higher percentages as a product of sample size. Mean fragment sizes were smallest in the two earliest periods, while in the Late Halaf/Ubaid sequence the average weight of bone fragments exceeded 5 g. However, even some of these relatively large fragments remained non-identifiable in the latest, Ubaid period sub-assemblage (Fig. 7.2).

Results

Mammalian remains

The analysis of over 3,000 bones and teeth from the Early Halaf to Ubaid sequence of Tell Aqab revealed an overwhelming dominance of domestic animals. These remains, however, were not evenly distributed across the archaeological periods. The Middle and Late Halaf components offer the most reliable information concerning meat consumption, widely considered a proxy to animal keeping. The distribution of the number of identifiable bone specimens (NISP) is summarized in Table 7.1.

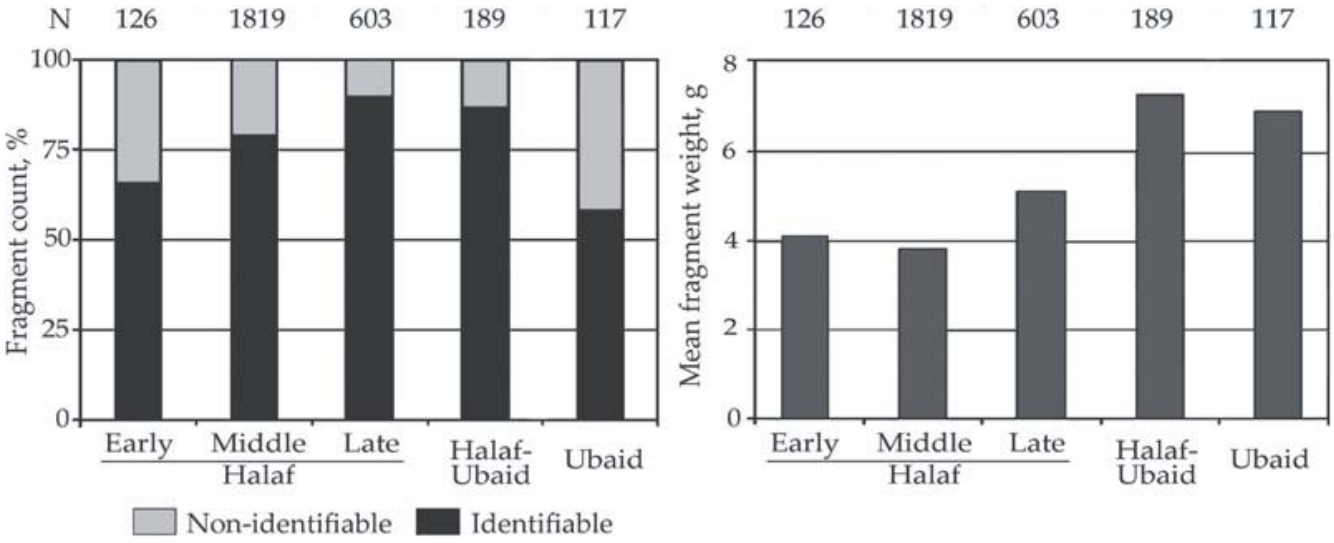

Fig. 7.2. The proportion of identifiable/non-identifiable mammalian remains (left) and the mean weight of bone fragments in light of assemblage sizes (N).

Table 7.1. The numbers of identifiable specimens (NISP) and non-identifiable remains by period.

	Early Halaf	*Middle Halaf*	*Late Halaf*	*Halaf-Ubaid*	*Ubaid*	*Total*
Sheep/goat (Caprinae)	46	917	330	81	17	**1,391**
Goat (*Capra hircus* Linné, 1758)	4	32	32	3	3	**74**
Sheep (*Ovis aries* Linné, 1758)		112	44	16	1	**173**
Cattle (*Bos taurus* Linné, 1758)	8	87	45	35	22	**197**
Pig (*Sus domesticus* Erxl., 1777)	24	262	70	14	11	**381**
Dog (*Canis familiaris* Linné, 1758)			2	2		**4**
Aurochs (*Bos primigenius* Boj., 1827)	1	3	10	1	2	**17**
Wild sheep (*Ovis orientalis* Gmel., 1774)		2				**2**
Wild pig (*Sus scrofa* Linné, 1758)		1		2		**3**
Red deer (*Cervus elaphus* Linné,1758)		13		3		**16**
Gazelle (*Gazella subgutturosa* Güld., 1780)		10	5		10	**25**
Wild ass (*Equus hemionus* Pall., 1775)		1	2	1	2	**6**
Brown hare (*Lepus europaeus* Pall., 1778)			1	6		**7**
Human (*Homo sapiens* Linné, 1758)		4	23	20		**47**
Total identifiable mammal	**83**	**1,444**	**564**	**184**	**68**	**2,343**
Small ungulate	23	312	41	10	9	**395**
Large ungulate	20	67	21	15	40	**163**
Non-identifiable mammal	**43**	**379**	**62**	**25**	**49**	**558**
Wading bird (cf. Ardidae)				1		
Bird of prey (cf. Accipitritidae)				1		
Little bustard (*Otis tetrax* Linné, 1758)				1		
Crow family (Corvidae)		1				
Aves, non-identifiable				1		
Bird total		**1**		**4**		
Total	**126**	**1,824**	**626**	**213**	**117**	**2,901**

There is a visible shift in the proportions between domestic ungulates (caprines, cattle and pig) throughout the chronological sequence that was found to be statistically significant in terms of the number of identifiable bones: the composition of sub-assemblages is not homogeneous (Chi^2=140.81, P<0.0001).

Assemblage sizes vary, therefore their taxonomic richness can be appraised only in relative terms. When decimal logarithms of the number of taxa in each period are plotted against the number of

identifiable specimens, the composition of the smallest, Early Halaf sub-assemblage looks most monotonous, its species repertoire being limited to only domesticates and a single bone from aurochs. On the other hand, the sub-assemblages transitional to the Ubaid Period and representing Ubaid itself are most diverse in light of their relatively small sizes (Fig. 7.3). Middle and Late Halaf as well as Ubaid animal remains fit the main trend between the two variables which are closely correlated: the resulting equation indicates that assemblage size determines the taxonomic diversity to 40%.

The taxonomic and chronological distribution of the archaeozoological assemblage from Tell Aqab is summarized by bone weights in Table 7.2, also reflecting the aforementioned dominance of Middle and Late Halaf components of the material.

Livestock was of overwhelming importance in meat provisioning throughout the history of Tell Aqab. At the beginning, the bones of sheep and goat (caprines) dominated fragment counts, however finds indicative of the consumption of beef (*i.e.* cattle bones) increased consistently in numbers, especially at the expense of pork. It is probably larger cattle bones that contributed to the diachronic increase of mean fragment weights in Figure 7.2. The steady increase in beef consumption and declining significance of mutton are clearly illustrated by both identifiable fragment numbers and bone weights in Figure 7.4 based on data listed in Tables 7.1 and 7.2.

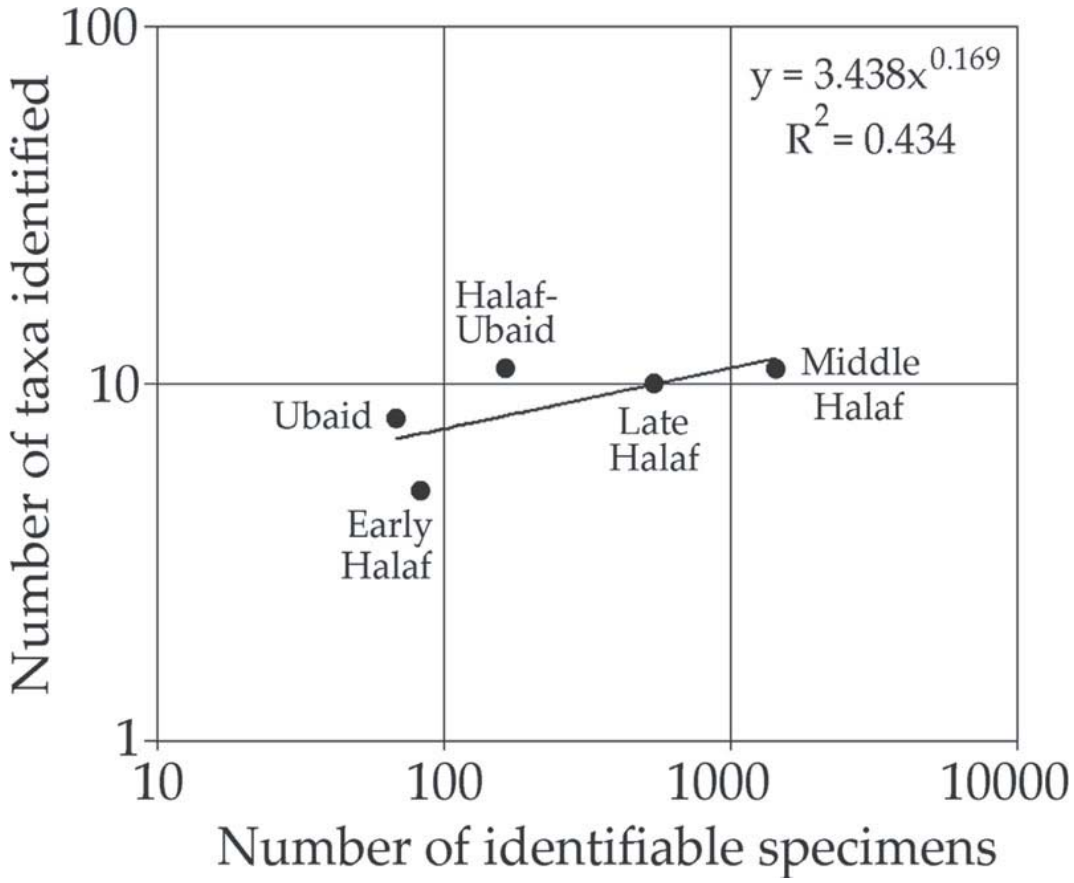

Fig. 7.3. The taxonomic richness of chronological sub-assemblages as the function of assemblage size (NISP).

Table 7.2. The taxonomic distribution of mammalian bone fragment weights (g) by period.

	Early Halaf	*Middle Halaf*	*Late Halaf*	*Halaf-Ubaid*	*Ubaid*	*Total*
Sheep/goat	137	2491	914	319	98	3,959
Goat	62	291	225	38	21	637
Sheep		751	175	109	11	1,046
Cattle	34	880	568	430	364	2,276
Pig	189	1,626	579	111	108	2,613
Dog		5	14	13	22	54
Aurochs	12		472	28	45	557
Wild sheep		55				55
Wild pig			12	76		88
Red deer		98		22		120
Gazelle		63	71		58	192
Wild ass		18	35	152	33	238
Brown hare			1	10		11
Human		214	14	162		390
Total identifiable mammal	434	6,492	3,080	1,470	760	12,236
Small ungulate	19	305	30	12	9	375
Large ungulate	67	155	79	40	40	381
Total non-identifiable mammal	86	460	109	52	49	756
Total	520	6,952	3,189	1,522	809	12,992

A relative increase in the contribution of pork is visible only in the small Ubaid sample, the least representative in statistical terms. The same trend is even more evident in bone weights which in general terms reflect meat consumption more reliably than the numbers of bone fragments as bone and meat weights are correlated in the live animal (Schmidt-Nielsen 1984: 15). Therefore it is a more direct reflection of meat weights than fragment numbers prone to differential fragmentation bias, even if the distribution of edible tissue represented by the weights of different skeletal parts evidently varies within the body (Bartosiewicz 2009: 99). Graphs in Figure 7.4 show that the initial dominance of caprine bone fragment numbers is misleading; there was an evident increase in beef consumption throughout the sequence at the expense of both mutton and pork. This trend is clear during the statistically most reliable Middle Halaf-Halaf/Ubaid transition interval but the small samples at either end of the chronological continuum fall in line with this observation. Explanations to this tendency may be both environmental and social.

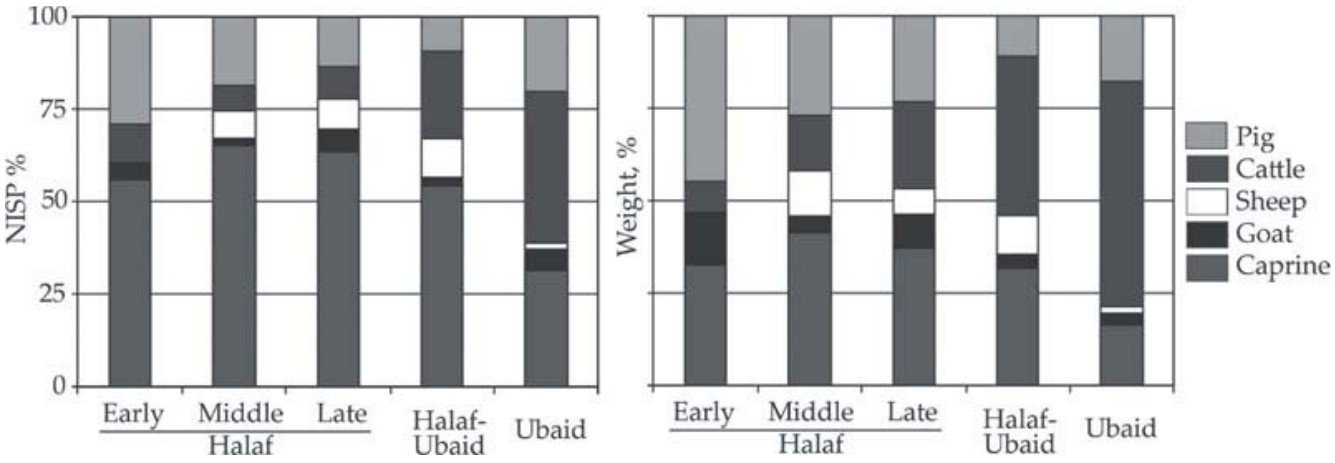

Fig. 7.4. Diachronic changes in the proportions between livestock remains in terms of the number of identifiable specimens (NISP) and bone weights.

Sheep/goat and pigs are comparable in terms of body size, *i.e.* meat weight, therefore they often complement each other when meat consumption habits change due to shifts in ecological or in cultural conditions. At Tell Aqab these two groups of small stock display a consistent pattern during the studied time period. According to Figure 7.5, sheep and goat supplied somewhat more meat than pigs in all periods. The overall proportion between their remains, however, was remarkably stable, close to the diagonal in both graphs indicating the only slight dominance of caprines in terms of the numbers of bones and more equal weights from caprines and pigs.

Bone weights suggest an especially balanced picture of pork and mutton consumption in the small Ubaid and Early Halaf samples, even if sheep and/or goat were always better represented in the meat diet of the site. A passing remark in the Tell Aqab excavation report is of special interest here:

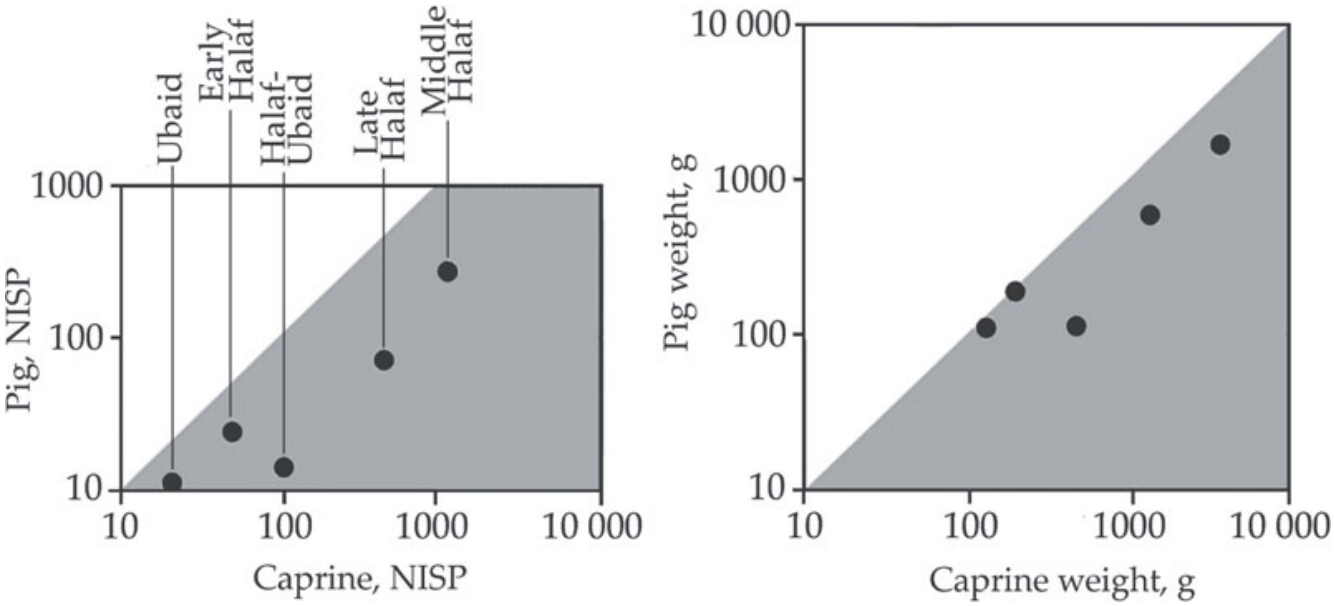

Fig. 7.5. Comparison between the numbers (left) and weights (right) of pig vs. *caprine bones. The distributions of periods are similar in both graphs.*

> "Trench 4 produced a number of [Ubaid period] small baked clay animal models, most of which seem to represent sheep. A few clay animal models were found in Halaf contexts at the site, but these were of a different type." (Davidson and Watkins 1981: 10)

Pig is mostly associated with household economies. In accordance with archaeobotanical evidence from Tell Aqab, pulse weeds and crops (McCorriston 1992) or refuse from crop processing may have been fed to pigs. This hypothesis has been put forward on the basis of dietary isotope analyses (Vaughan *et al*. 2013: 311). Pig bones from Tell Aqab showed a significantly lower average $\delta^{15}N$ value than Chalcolithic pigs from Çamlıbel Tarlası (Central Anatolia) reared in a woodland environment, possibly less in need of complementary feeding.

In contrast to pork, consuming beef is to some extent a luxury partly since the reproduction rate of large animals is low. This holds especially true if the animal is slaughtered young; eating meat from a spent draught animal may be rather seen as a contingency. Slaughtering a single cattle, however also yields approximately ten times as much meat as a sheep or a pig. Therefore (if large scale meat preservation operations are discounted) increasing beef consumption may be indicative either of relatively centralized meat distribution at the site or major groups of people who would consume the meat in a relatively short time.

The last domestic animal to be discussed is dog, whose sporadic bones occurred in all but the small Early Halaf Period sub-assemblage. It is unlikely that these animals were eaten. The few remains originate from relatively small individuals characteristic of prehistoric sites across Eurasia where breeding was most probably not practiced (Bartosiewicz 2002). A small calcaneus falls in the size range of foxes. In addition to direct osteological evidence, signs of dog gnawing in the refuse bone material (Fig. 7.6) also illustrate scavenging by dogs at the settlement.

Osteometric analysis was made difficult by the heavy fragmentation of the material as is indirectly shown by the absence of complete long bones that could have been used in withers height estimations. There were relatively few measurable animal bones in the material (see Appendix). These offer little information in themselves but contribute to the ever-growing corpus of osteometric information from southwest Asia.

The only exception is sheep and, in general terms, the subfamily of caprines. Sheep from the large Middle Halaf as well as the Late Halaf and Halaf-Ubaid sub-assemblages could be compared to each other, plotting the standard scores of various bone measurements within the same graph. The logic of calculating standard scores is the basis of the more complex variability size index calculations developed by Uerpmann (1982) in dealing with fragmentary Halaf period equid and gazelle remains. Both techniques address the problems posed by small numbers of measurable specimens by pooling metric information from different skeletal elements. Standard scores were calculated using a group of 26 adult female Shetland sheep reference skeletons as a standard (Davis 1996: 596, table 2). Mean values and standard deviations for each long bone measurement calculated for these animals provided the background for the current analysis. Each type of individual measurement from Tell Aqab (*e.g.* tibia distal width Bd) was compared to the mean value and standard deviation of the same measurement in the Shetland sample. This way, archaeological measurements can be shown in relation to the mean and two sigma values of Shetland ewes. This method was successfully used in the analysis of Neolithic sheep in Hungary and Calabria, southern Italy (Bartosiewicz 2007: Fig. 14.8; Gál and Kovács 2010: fig. 17).

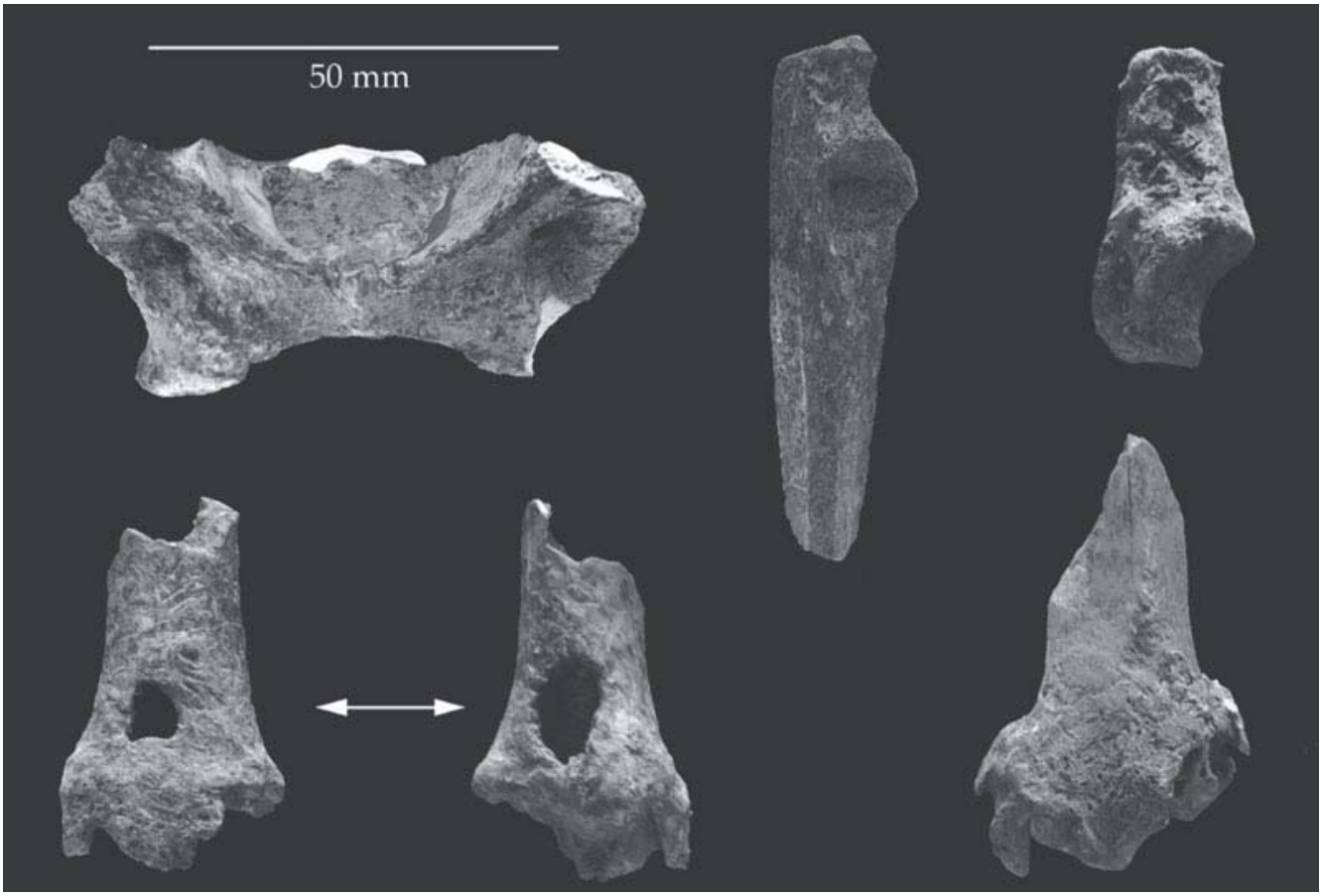

Fig. 7.6. Dog atlas and ulna fragment, calcaneus from a small canid (top). Two aspects of a sheep tibia showing characteristic damage by dog gnawing and a sheep distal tibia fragment covered by exostoses.

It cannot be stressed enough that comparison to the Shetland data set is not meant to suggest any meaningful relationship between prehistoric sheep in Tell Aqab and this extant breed. Figure 7.7, however, is useful in appraising the size distribution of sheep bones within the Tell Aqab assemblage itself.

In relation to the ±1 standard deviation marked around the standardized Shetland mean value (0) the set of pooled measurements is slightly shifted toward the right indicating that sheep at Tell Aqab were larger than Shetland ewes. Likely females fall within the shaded zone of Shetland ewes and beyond in Figure 7.7, with bones from larger rams and possibly castrates forming a small group beyond the +3 standard score range of Shetland ewes. A few unusually small measurements may be attributed to subadult sheep, while the group of largest measurements may include bones from autochtonous wild sheep.

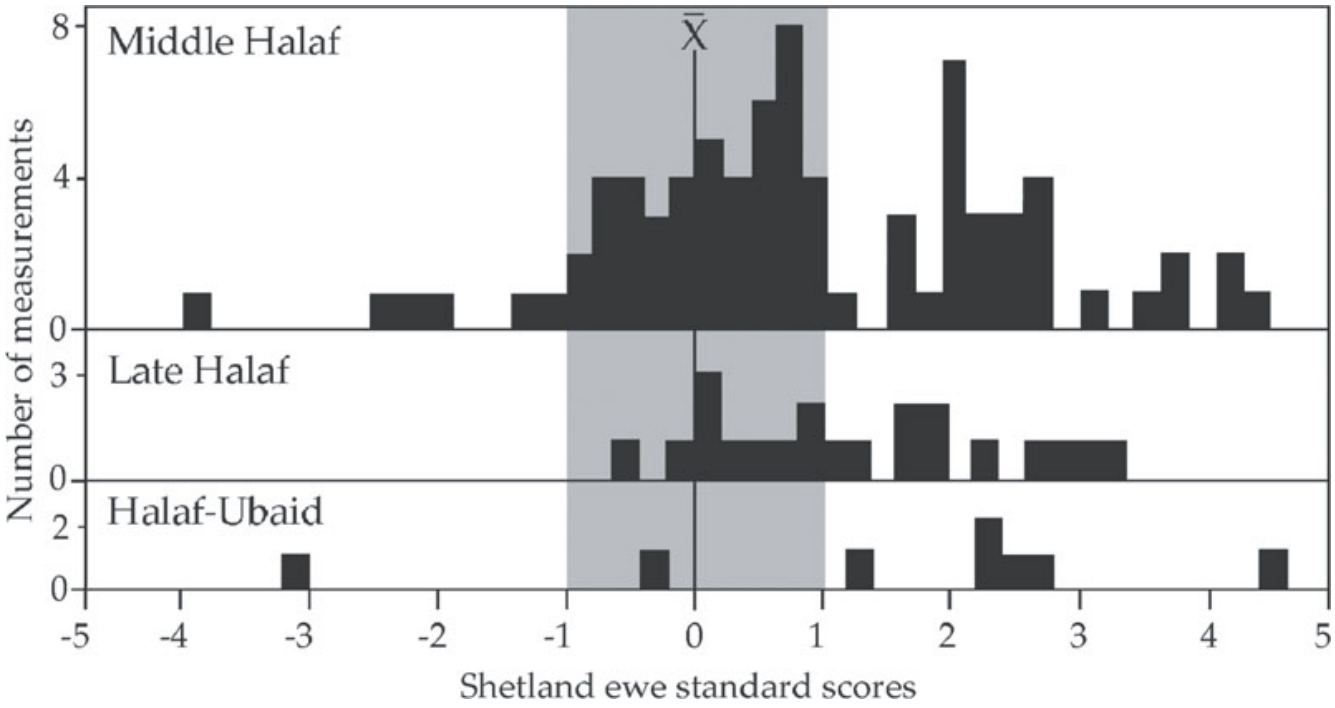

Fig. 7.7. The size distribution of Tell Aqab sheep bones against the background of statistical parameters of 26 Shetland ewe skeletons. The 2-σ boundaries of Shetland ewe measurements are marked by shading.

Livestock age distributions

Ageing the Tell Aqab remains was based on a combination of tooth eruption sequences and data on epiphyseal fusion derived from present-day reference animals of known ages (Chaix and Méniel 2001; Schmid 1972: table ix; for a synthesis see Table 7.3). While the *terminus ante quem* age of death can be relatively easily determined from disarticulated teeth and bone using standard methodologies, interpreting the resulting data is not easy. The logical argument that the remains most commonly encountered at the excavation originate from the taxa kept in the largest numbers is only a tendency in very large, representative samples. However, when only small assemblages are available for study, applying this logic uncritically can lead to spurious speculations frequently described in the allegoric language of "herd management strategies" which has little to do with the reality of randomly recovered food refuse decimated by taphonomic loss. The general knowledge that porous bones of juvenile animals are more prone to destruction cannot be consistently quantified when sites are compared. As Bibikova (1981) pointed out, due to their earlier ages of slaughter pigs as a species may be underestimated owing to the greater degree of attrition of their bones. Unfortunately, not even the sieved sample yielded a sufficiently large number of deciduous teeth to help appraising the extent of this loss.

Although each ageable skeletal part was recorded in the Tell Aqab material, age groups were compared only for the most commonly occurring species of livestock. Comparisons were based on relative terminology whose categories are summarized in months in Table 7.3.

Table 7.3. Absolute ages (months) of tooth eruption (permanent) and epiphyseal fusion in modern domesticates.

Skeletal element	Absolute age (months)			Age class
	Cattle	Caprine	Pig	
metapodia proximal	0	0	0	neonate
P_1 tooth			6	neonate
M_1 tooth	6	6	6	neonate
radius proximal	12–15	3–6	12	juvenile
M_2 tooth	14	12	12	juvenile
humerus distal	15–20	3–4	12	juvenile
I_1 tooth	22	14.4	12	juvenile
P_3 tooth	24	21.6	12	juvenile
tibia distal	24–30	12–18	24	subadult
metapodia distal	24–30	16–18	24	subadult
P_2 tooth	26	18	12	subadult
I_2 tooth	26	21.6	14.4	subadult
M_3 tooth	26	21.6	18	subadult
P_4 tooth	34	24	14.4	adult
I_3 tooth	36	33.6	9.6	adult
calcaneus	36	36	24–30	adult
femur proximal	36	20–26	36	adult
ulna distal	36	26–32	36	adult
radius distal	40–48	23–30	42	adult
femur distal	42	18–26	42	adult
ulna proximal	42	25–35	42	adult
humerus proximal	42–48	25–36	42	mature
C tooth	46	45.6	9.6	mature
tibia proximal	48	20–26	42	mature
vertebral epiphyses	54–60	48–60	48–84	mature

The sequence of absolute ages is similar between the three taxonomic groups (as is between sheep and goat). Relative age groups between neonate and mature individuals used in this study fall within this age continuum. The numbers of ageable skeletal elements for caprines, pig, and cattle at Tell Aqab are documented by relative age categories in Table 7.4.

As shown by the tabulated results, it is only the Middle and Late Halaf sub-assemblages (total ageable NISP=633 and 182 respectively) where a sufficiently great number of bones were available to warrant interpretation. The rest only mirror marked trends such as the presence of remains from young animals among pigs contrasting the high age of cattle. Figure 7.8 is a visual summary of age groups in the food refuse from these two, best represented time periods.

One conclusion immediately offered by Figure 7.8 is that the Middle Halaf sub-assemblage (over three times the size of the Late Halaf material) shows a more consistent trend. According to this, only half of Middle Halaf sheep and goat bones originate from mature individuals. The higher percentage of younger bones in the generic category of caprines is attributable to identification bias: distinguishing between sheep and goat is particularly difficult when unfused bones of the young need to be aged. Among pigs, two thirds of the Middle Halaf bones originated from immature animals, including neonates and juveniles. In contrast to these results, beef consumption was rarely represented by anything but the remains of mature individuals. Similar results in the Late Halaf sub-assemblage are obliterated by small sample size.

Table 7.4. The distribution of pooled relative dental and epiphyseal ages (NISP) in livestock.

	Sheep	*Goat*	*Caprine*	*Pig*	*Cattle*
			Early Halaf		
Neonate					
Juvenile			2	1	
Subadult			2	3	
Adult				3	
Mature		4	4	5	3
Total ageable	**0**	**4**	**8**	**12**	**3**
			Middle Halaf		
Neonate	1		9	6	
Juvenile	3		15	14	
Subadult	6	1	52	33	3
Adult	27	12	109	41	3
Mature	40	13	139	56	50
Total ageable	**77**	**26**	**324**	**150**	**56**
			Late Halaf		
Neonate	1		2	1	
Juvenile	2	2	10	13	
Subadult	9	4	12	9	1
Adult	3	10	44	9	3
Mature		3	11	15	18
Total ageable	**15**	**19**	**79**	**47**	**22**
			Halaf-Ubaid		
Neonate			1		
Juvenile			2		
Subadult	1		5	4	1
Adult	4		7	5	1
Mature	10	3	35	2	24
Total ageable	**15**	**3**	**50**	**11**	**26**
			Ubaid		
Neonate					
Juvenile				1	
Subadult				7	
Adult					
Mature	1	3	2	3	11
Total ageable	**1**	**3**	**2**	**11**	**11**

One may be fairly confident that well-established post-Neolithic animal husbandry at Tell Aqab

benefited from the secondary exploitation of livestock. The production of renewable goods such as milk, wool and draught work results in longevity. In both periods, however, pork originated from younger age cohorts, while beef was mostly gained from fully mature individuals. Consumption of meat from sheep and goat show results transitional between these extremes. Aside from milking and/or shearing these two species, their slaughter at higher ages than those of pig may be explained by their less prolific, uniparous nature. The rate of reproduction for large stock such as cattle is especially slow contributing to the animals' great individual value. It may be presumed that the diachronically increasing availability of beef from mature individuals was also in connection with using cattle power in tillage. However, the only bone showing arthrotic deformations in the Tell Aqab assemblage originates from the hock joint of a sheep (Fig. 7.6, bottom right).

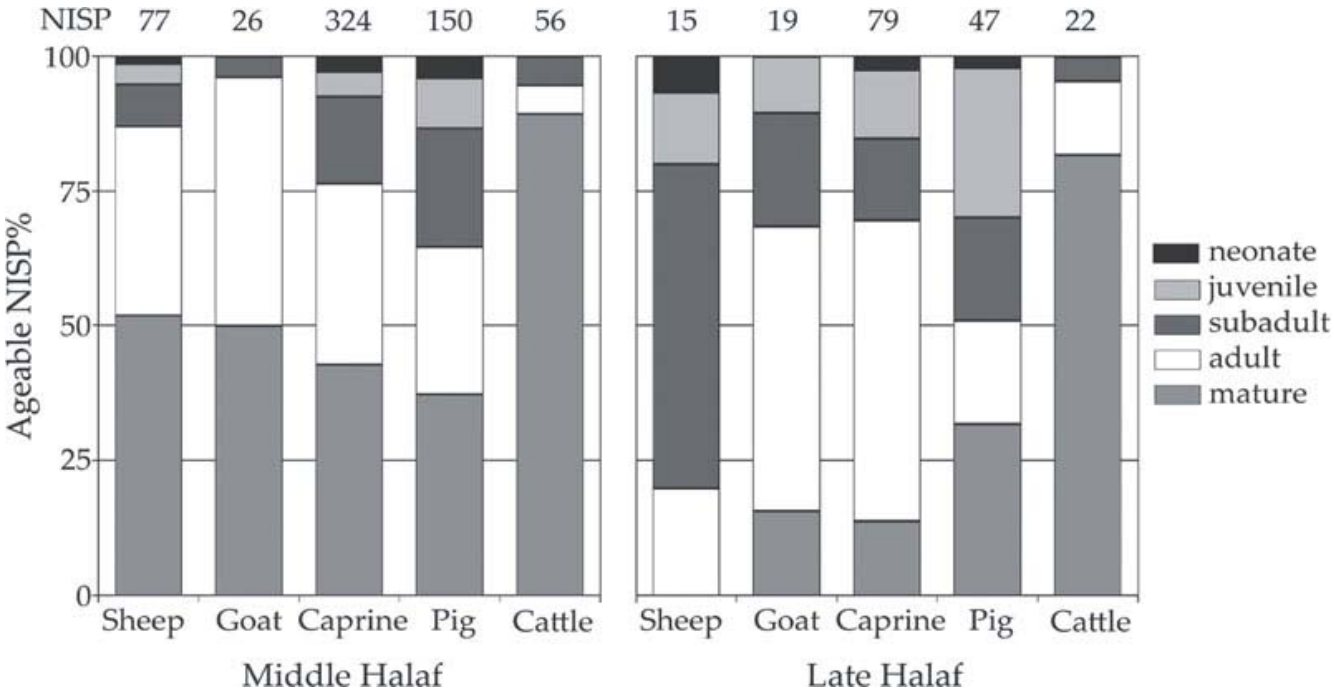

Fig. 7.8. The NISP percentages of relative age groups in Middle and Late Halaf livestock.

Wild mammalian remains

The remains of game animals reflect environmental conditions in the fertile Khabur triangle. Sporadically occurring wild animal bones are characteristic of the rich ecotone between the plains and foothill zone. Although the role of wild animals in meat provisioning was negligible, the remains are indicative of both woodland (red deer, wild pig) and grassland (gazelle, wild ass, and brown hare) habitats in the settlement's environment. Large-bodied red deer and wild pig prefer wooded areas, such as gallery forests in the floodplain where they find sufficiently tall vegetation cover.

Goitered gazelle and wild ass (Fig. 7.9) would have ranged across the open steppe flanking the Khabur floodplain. A single measurable cattle bone fell within the size range of aurochs. Based on present-day habitat preferences and geographical distributions hare bones were attributed to [Eurasian] brown hare rather than cape hare (*Lepus capensis* Linné, 1758) recorded today only in the arid southern section of Syria.

The Late Halaf and Halaf-Ubaid occurrence of hare bones helps fine-tuning the interpretation of "increasing reliance on hunted animals". Especially in the small Halaf-Ubaid sub-assemblage six of the

13 wild animal bones originated from hare whose opportunistic hunting cannot be compared to confronting aurochs or chasing wild ass in terms of skill, courage or group cooperation. Together with four bird remains from the same sub-assemblage it is the broadening spectrum of animals targeted, rather than their quantity of meat that is of significance here.

Weaponry is also worth briefly considering as indirect evidence of hunting. No stone projectile points are known from either the Halaf or Ubaid strata of Tell Aqab and traumatic bone lesions attributable to hunting are likewise missing in the small set of wild animal remains. Davidson and Watkins (1981: 11), however, mention "large numbers of biconical baked clay sling bolts … found in both contexts", adding that "sling bolts of this type occur quite commonly on other Halaf and Ubaid mounds in the Khabur region". One of the Tell Aqab clay sling bolts came to light from the earliest Ubaid deposit radiocarbon dated to 5,266–4,995 BCE (Hole 2001: 73).

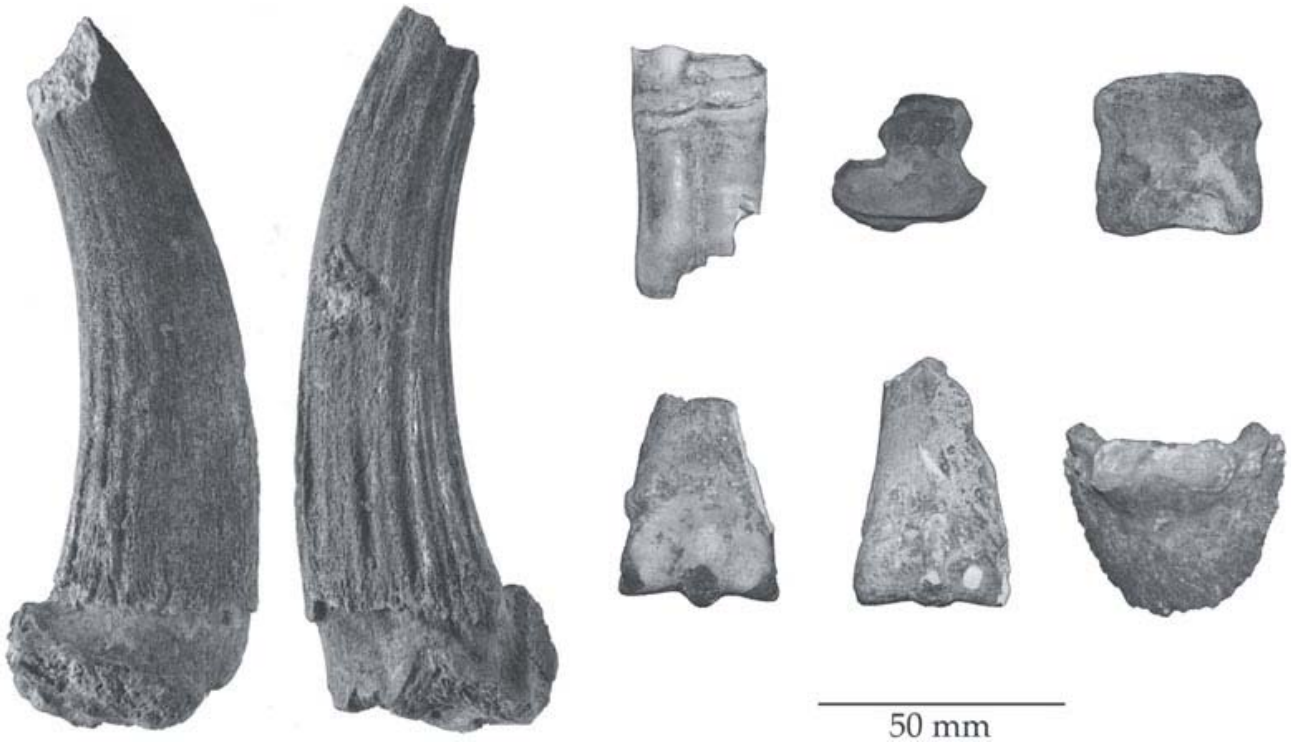

Fig. 7.9. Lateral and medial aspects of a large gazelle bock's horn core (left); Wild ass lower molar tooth, carpal bone and median phalanx (right top); Wild ass distal metacarpus and metatarsus fragment and distal phalanx (right bottom).

Avian bones

Only five bird bones were found in the material. One of them came to light from the largest Middle Halaf sub-assemblage, four originated from the small but unusually rich Halaf/Ubaid transitional material in which 164 identifiable mammalian bones represented 11 taxa. These four bird bones thus confirm the impression of great taxonomic diversity in the Halaf-Ubaid sub-assemblage in spite of its small size. Due to high fragmentation and the absence of a reference collection of local avian bones from northeast Syria possibilities of identification were limited to appraising the gross taxonomic position (Fig. 7.10) and habitat preferences of the birds represented at Tell Aqab.

The Middle Halaf period material yielded the diaphysis fragment of a right humerus from a medium-size species in the crow family (Corvidae; Fig. 7.10 extreme right). Corvids tend to easily

adapt to commensal lifestyles in the proximity of humans, although their meat may also be consumed (Bartosiewicz 2003: 39).

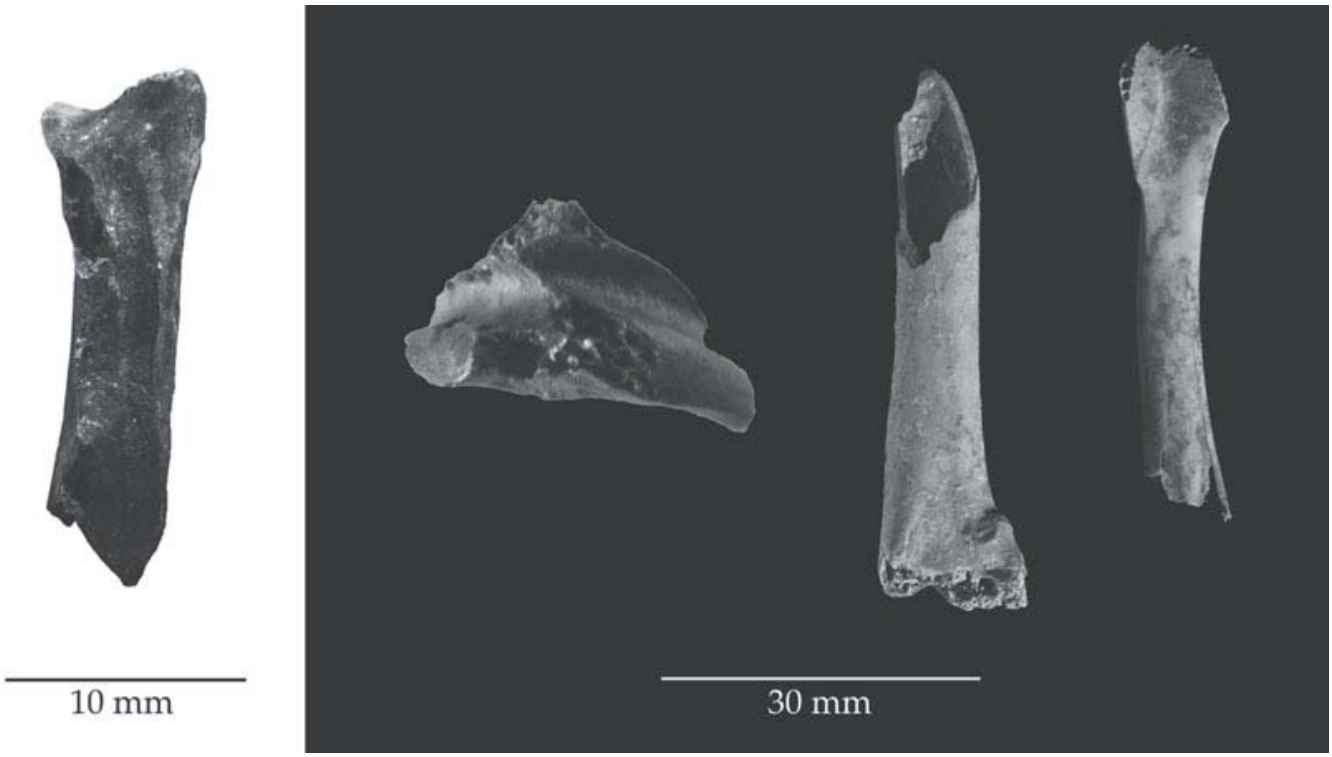

Fig. 7.10. Little bustard phalanx from the wing, cranial aspect of asymmetric sternum fragment from a goose-size bird, and raptor humerus diaphysis fragment from the Halaf-Ubaid sub-assemblage (left). Middle Halaf corvid humerus diaphysis (far right).

The small but interesting set of Halaf-Ubaid avian bones included a small sternum fragment from a goose-size bird that retained the robust, well-preserved articular surfaces of coracoid bones (Fig. 7.10). Due to their slightly asymmetric junction point the possibility must be considered that this bone originated from a heron (Ardeidae) characterized by the unequal development of these articulations (Selstam and Selstam 1982: 35, Fig. 7.10). Of the most common heron species it is the great egret (*Egretta alba* Linné, 1758) whose breeding area in Turkey is adjacent to the surroundings of Tell Aqab (Cottridge and Porter 2005:22). A right humerus diaphysis fragment originates from a medium size raptor (*cf*. Accipitriformes) although nocturnal birds of prey cannot be excluded in the absence of further morphological detail. Probably eastern little bustard (*Otis tetrax cf. orientalis* Hartert, 1916) is represented by a proximal phalanx from the second digit of the wing. Little bustard is a breeding visitor between the Russian Black Sea coast and Lake Balkhash (Kazakhstan). Importantly, it is a winter visitor along the southern shores of the Caspian Sea (Collar *et al*. 2014). It is indicative of steppe-like habitats, short-grass plains and pastures. Finally, a small ulna diaphysis fragment showing dashed line-lake papillae could not be more precisely identified.

Birds bones are rarely reported from contemporaneous sites. Most of the sporadically identified avian remains tend to be indicative of fowling in wetlands. Stork (*Ciconia cf. ciconia* Linné, 1758) was identified at Shams ed-Din (Uerpmann 1982) and Tell Sabi Abiyad (Cavallo 2000). The latter site also yielded remains of "duck" including mallard (*Anas platyrhynchos* Linné, 1758). Remains of unspecified goose (Anser sp.) came to light at Yarim Tepe II (Bibikova 1981). Excavations at

Girikihaciyan yielded remains of partridge (McArdle 1990), most probably chukar partridge (*Alectoris chukar* Gray, J.E., 1830) based on the present-day distribution of this species (Cottridge and Porter 2005: 42).

Discussion

Observations made at Tell Aqab in the upper Khabur basin need to be seen in a regional context. It seems that following well-established caprine herding during the Halaf Period the importance of beef increased and meat production was increasingly complemented with broad-spectrum hunting and gathering during the transition to the Ubaid Period.

General trends

Results obtained at this site were evaluated within the framework of 33 published Halaf and Ubaid assemblages (Grossmann and Hinman 2012: tables 9–10; Saña *et al*. 2001; Zeder 1998a). Testing proportions between the remains of domestic and wild animals is usually the first approach as NISP values for taxa are most commonly published. The role of prehistoric hunting in subsistence may be considered inferior when wild animal bones contribute less than 10% to NISP (Bartosiewicz 2007: 291). When a more generous 80% minimum threshold of NISP is set for domesticates the assemblages under discussion may be sub-divided as shown in Table 7.5.

In spite of the visual trend that Ubaid settlements with over 20% of wild animal remains are more common, this set of data may be considered homogeneous from a statistical point of view (Chi^2=0.55, df=1, P= 0.458). The coefficient of association also shows that on the basis of this data set the concepts of cultural affiliation and consumption of domestic *vs*. wild animals are basically unrelated (Phi=0.129).

Table 7.5. The number of faunal assemblages by culture and percentages of wild animals.

	Domestic >80%	*Domestic <80%*	*Total*
Halaf	13	9	22
Ubaid	5	6	11
Total	18	15	33

A possible source of bias is that this percentage-based calculation disregards sample size. As was shown in Figure 7.3, taxonomic diversity is a function of NISP. Given the large number of small (NISP<500) assemblages in this data set the question must be posed whether the high relative (%) contribution of wild animal remains is simply an artefact of insufficient sample sizes as has been demonstrated in the case of Early Neolithic Körös culture sites in Hungary (Bartosiewicz 2007:297). However, the value of Spearman's rank correlation (Rho=0.038; P=0.834) shows that in the set of 33 Halaf/Ubaid assemblages the association between NISP and the percentage of wild animal remains is

not statistically significant. This becomes more understandable when the distributions of these two variables are compared in Figure 7.11.

Assemblage sizes (absolute NISP values) could be best described in terms of a general Chi^2 distribution (between a large number of small and a very few large assemblages shown in the declining left to right trend in overall NISP values in Fig. 7.11). The relative percentual contribution of wild animal remains, however, shows a far less marked diminution in the right histogram. The reason behind this difference is that ratio values (such as the percentage of wild animal remains) can be randomly influenced by the differing distributions of their numerator (wild animal NISP) and denominator values (total NISP; Atchley *et al*. 1976). This is why percentage values need to be interpreted cautiously, especially when small assemblages are involved in the comparison.

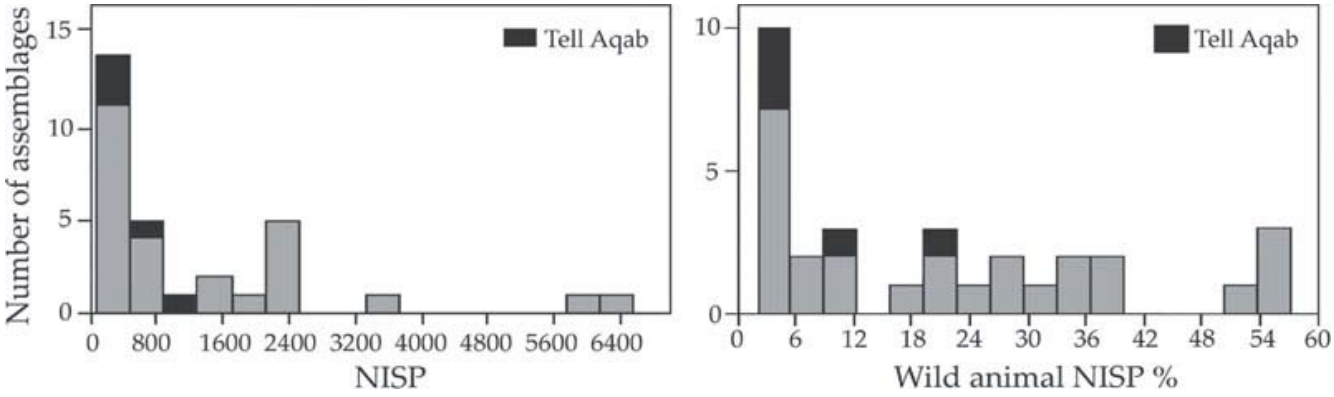

Fig. 7.11. The distribution of 33 archaeozoological assemblages by size (NISP) and the percentage of wild animal remains.

For twenty settlements where both estimates of the occupation area and wild animal percentages were available the same coefficient (Rho=-0.143, P=0.547) showed a similar lack of significant correlation on the basis of the 20 studied assemblages.

Halaf period

The Middle and Late Halaf sub-assemblages of Tell Aqab of reliable size overwhelmingly dominated by caprine remains (60% of NISP) and even pig bones are more numerous than those of cattle. Hunting in grassland environments is indicated by the sporadic remains of gazelle, wild ass, brown hare and aurochs bones. Red deer and wild pig, typical woodland animals, are represented only among the most numerous Middle Halaf remains. By the Late Halaf period (*ca*. 5,000–4,500 BC) the distribution of Halaf ceramics covered an extensive region (Davidson and McKerrell 1976: 53). Major middle 5th millennium Late Halaf assemblages are known from hilly southeastern Anatolia. They are similarly characterized by an overwhelming dominance (>90%) of domestic animals, including numerous caprine remains (Girikilhaciyan: NISP=2,132, McArdle 1990; Çavi Tarlası: NISP=3,500, Schäfer and Boessneck 1988).

The small contemporaneous assemblage from Banahilk (NISP=810, Laffer 1983) toward the east in Iraq is characterized by a similarly high contribution of domesticates lead by caprines. Late Halaf animal remains from Khirbet esh Shenef (NISP=387, Hendrichs 1990) in the Balikh Valley toward the west contain over one third wild animal remains.

According to Uerpmann (1982: 44) a 20% NISP for wild animals is “normal” at Neolithic sites in

the Near East, and the same holds true for Halaf settlements regardless of size. Wild animal remains may even exceed half of the NISP at both small sites such as Shams ed-Din (Uerpmann 1982) or Umm Qseir (Zeder 1994) and large permanent settlements as has recently been demonstrated by Grossmann and Hinman (2013: 207) at Zeidan even if the sample of identifiable Halaf period bone remains was rather small. Of these sites Umm Qseir 70 km south of Tell Aqab on the left bank of the Khabur River is in a precarious position not only due to less precipitation. Deposits of Mediterranean brown soil favorable to successful crop cultivation are limited to the narrow river banks beyond which gypseous soils set further limitations on arable farming (McCorriston 1992: 319). The xeric mediterranean forest-steppe vegetation of the north near Tell Aqab is replaced by sub-desertic steppe flora. It may partly be due to these factors that remains of wild mammals not only dominated at Halaf period Umm Qseir, but their contribution also increased through time. While caprine bone weights declined only slightly at this site, the consumption of flesh from wild ass increased at the expense of pork during the Halaf period. The 8:25% ratio of bone weights reversed to 27:7% (Zeder 1994: table 4). As was mentioned, the natural foraging of pigs may have been complemented even in the far more fertile environment of Tell Aqab.

Ubaid period

While Tell Halaf existed in the immediate vicinity of Tell Aqab, the other type site, Tell al-'Ubaid is located 1000 km souhwest in southern Mesopotamia. Ubaid material culture, characterized by wheel-thrown painted ware reached distant regions, including Upper Mesopotamia and Anatolia. The Halaf-Ubaid transitional material culture spanned the time period between the Neolithic and Chalcolithic in the region (Watkins and Campbell 1987). Animal remains in the Tell Aqab food refuse are indicative of a slight increase in hunting especially at the initial time of transition. It is also this time when the otherwise small sample is richest in mammalian species and the presence of birds was best established.

The relationship between "culture" and the contribution of wild animals to the diet was tested in Table 7.5 at three major sites where both Halaf and Ubaid remains were available. All Halaf mammalian bones (excluding humans) from Tell Aqab were compared to the far smaller pooled sample of transitional Halaf-Ubaid+Ubaid remains. Additional data in the table include the reverse proportions between Halaf and northern Ubaid NISP values at Tell Zeidan at the confluence of the Balikh and Euphrates Rivers near the 200 mm isohyet in northern Syria (Grossmann and Hinman 2012: table 2). Halaf and Ubaid components at Tell Kurdu near the Mediterranean coast (Özbal 2006) within the 400 mm isohyet offer another example where the contribution of domesticates apparently increases but the two periods are represented by sub-assemblages whose sizes differ by an entire order of magnitude.

Table 7.6. Comparison between major archaeozoological assemblages having both Halaf and Ubaid components.

	Tell Aqab		*Tell Zeidan* (Grossmann and Hinman 2012)		*Tell Kurdu* (Özbal 2006)	
	Halaf	Transition-Ubaid	Halaf	Ubaid	Halaf	Ubaid
Domestic NISP	2015	205	124	2181	5043	126
Wild NISP	49	27	137	241	1506	4
Wild mammal %	2.4	13.3	52.4	9.9	23.0	3.0
Chi^2	55.923		352.263		28.969	
Df	1		1		1	
P	0.000		0.000		0.000	
Phi	0.156		0.362		0.066	

The results summarized in Table 7.6 show that the Halaf *vs*. Ubaid assemblages are not homogeneous in terms of the presence of wild animal remains, the difference visible in the proportions between domestic and wild animal remains are significant in formal statistical terms ($P \leq 0.05$). Coefficients of association (Phi), however, are indicative of a definite but weak relationship between cultural affiliation and the contribution of wild animal remains only at Zeidan. At Tell Aqab and Tell Kurdu this relationship may be considered random, an artifact of differences between percentages too small to counterweigh inequalities in sub-assemblage sizes.

Ubaid meat provisioning also relied largely on domesticates according to smaller assemblages from Kenan Tepe in Anatolia (Parker *et al*. 2008) and at Khanijdal East in Iraqi Jezirah (Wilkinson and Tucker 1995). Other Ubaid period assemblages offer evidence of substantial hunting (Akkermans and Schwartz 2003: 175). In the Khabur Valley, the assemblage from Ziyadeh (57%, NISP= 2063, Zeder 1998b) across from Umm Qseir, and Mashnaqa (31%, NISP=1273, Zeder 1995 and 1998a, 1998b) south of the 200 mm isohyet are of most immediate relevance. In these cases harsher environment may be an important background variable, as it was the case in the southern section of the Khabur Valley during the 6th millennium (Zeder 1998b: 572). Further upstream on the Euphrates (across from Tell Halula), the small Ubaid site of Kosak Shamali (39%, NISP=246, Gourichon and Helmer 2003) is also characterized by a greater reliance on wild resources.

Conclusions

Animal remains from the University of Edinburgh's excavations at Tell Aqab contain important information on meat consumption in the Halaf and northern Ubaid periods in the upper Khabur Valley. In comparison with settlements toward the south, Halaf and Ubaid Period Tell Aqab was located in a fertile Mediterranean forest-steppe environment in the "heartland" of the Halaf Culture (Davidson 1977: 9–10). Evidence of 6th-millennium animal exploitation is indicative of adaptation to ecological

conditions less hostile to subsistence farming than in the semi-arid south.

A polarization of settlement sizes at this time is seen as evidence of increasing social complexity. Growing concentrations of human populations may be characterized by an increasing focus on domesticates whose production and distribution is specialized and can be closely regulated (Zeder 1991). Small rural settlements are often seen as temporary habitations that relied on small-scale pastoralism and extractive subsistence techniques. Given that better established settlements are located in the northern reaches of the Halaf distribution area in Syria and Turkey, environmental factors such as the carrying capacity of arable land contributed to these differences.

One social factor, however, may also have been of importance, especially in dry, marginal regions. The great diversity of meat consumption shown by animal bone assemblages is yet another reminder that Halaf as an archaeological culture has been identified by a wide spread fashionable painted ware. Its actual spatial distribution is, more or less, unrelated to the diversity of lifeways at various settlements where it can be found. Neutron activation assays of Halaf ware have confirmed that Tell Aqab was a node in the complex network involved in the distribution of this popular style (Davidson 1981: 76).

Halaf ware connects a network of small settlements sometimes only 1–2 ha in size (Davidson 1977). Early models of Halaf cultural development sought to integrate such sites within developments in social complexity. Frangipane (2007: 161) suggested that the "egalitarian character" of 6th-millennium BC communities was not conducive to supporting large groups of people: newly created satellite settlements that sprouted out of large settlements asserted their cultural relations with their forebears through conservative elements in the material culture such as the characteristic painted ware used to define the Halaf Period. The resulting stylistic homogeneity, thus, can be seen as a perpetual effort to maintain social cohesion in newly formed groups over a large area characterized by great environmental diversity.

Although hierarchical systems may have started to emerge during the Halaf and Ubaid periods in the region, convincing material evidence for this phenomenon is, to say the least, limited. The occurrence of new, Ubaid style ware may be a reflection of intensification in social reorganization under the influence of developments to the south on the Mesopotamian Plain. What is interesting in the analysis of the animal remains is that a different aspect of material culture, meat and the way it was consumed as well as the general attitude to animals reveals very different forms of adaptation to both the natural and social environments.

There are signs of broad spectrum animal exploitation at the time of the Halaf-Ubaid transition. The question therefore arises whether the increasing importance of hunting (more exactly the consumption of game) was a contingency or a luxury stimulated by socio-political developments. While patterns of hunting vary strongly in the wider, variegated natural environment of the Khabur Valley, at Tell Aqab, favourable geographical conditions support arguments against direct environmental determinism. Agriculture and grazing inevitably cause deforestation, lower tree densities meant that cover for large game was reduced.

The worst case scenario would be that under the pressure of the social changes indicated by the occurrence of Ubaid ware in the region, domestic sources of meat had to be complemented by hunting for game. A similarly possible scenario, however, is that increasing social competition is expressed in the consumption of a greater variety of animals. This hypothesis is also consonant with the fact that the

contribution of game to the Tell Aqab diet remained relatively low at this time. On the other hand, beef consumption increased relative to both mutton and pork. Due to the low rate of reproduction, the return on large livestock keeping is slow. In terms of consumption, the distribution of meat from larger animals also takes more planning and possibly control. Along with these physiological/physical characteristics in many cultures cattle are a prime way of displaying wealth and showing status.

Comparisons between published archaeozoological results treated as metadata are known to pose numerous methodological problems. Even in the case of the standardized presentation of primary NISP values, nagging issues of local taphonomy and the frequent lack of high resolution absolute chronology are difficult to systematically address in terms of statistically testable hypotheses. However, such data are useful in appraising gross trends in taxonomic diversity and sampling as part of the individual evaluation of sites.

In relatively rich, variegated ecotone habitats such as the surroundings of Tell Aqab, animal keeping and hunting should not be juxtaposed as dichotomic forms of subsistence. There may be a number of cultural and economic reasons why sedentary agriculturalists may occasionally hunt. "Resort to hunting" would be a culturally charged way of characterizing this alternative, as there are probably various motivations behind people deciding to exploit the wild fauna. It is therefore of utmost importance that we better understood the diversity of Halaf and subsequent Ubaid period subsistence between the dry-farming optimum in the north and its environmental opposite in the arid periphery toward the south.

Acknowledgements

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Appendix: Measurements in mm, abbreviations after von den Driesch 1976

Additional abbreviations:

L = greates molar length

GB = greates molar breadth

Ect = Ect-Ect, greatest frontal breadth

Ent = Ent-Ent, breadth between the orbits

Sdd = smallest anterio-posterior depth

EH = Early Halaf

MH = Middle Halaf

LH = Late Halaf

H-U = Halaf-Ubaid

U = Ubaid

Period	*Bone*	*Age*	*Side*	*GL*	*Bp*	*Dp*	*SD*	*Sdd*	*Bd*	*Dd*
Cattle										
MH	radius	mature	dex.						77.5	48.2
MH	tibia	mature	sin.						73.5	54.3
LH	tibia	mature	sin.						53.5	40.0
LH	metatarsus	mature	sin.		43.2	42.8				
Sheep									L	GB
MH	lower M3 tooth	adult	dex.						22.6	8.5
MH	lower M3 tooth	adult	sin.						22.8	8.1
MH	lower M3 tooth	adult	sin.						22.8	8.0
MH	lower M3 tooth	mature	sin.						23.1	8.2
MH	lower M3 tooth	mature	dex.						23.2	8.4
MH	lower M3 tooth	adult	dex.						24.1	8.9
MH	lower M3 tooth	mature	dex.						24.1	8.7
MH	lower M3 tooth	adult	sin.						24.1	8.7
MH	lower M3 tooth	mature	dex.						24.2	8.5
MH	lower M3 tooth	mature	dex.						24.2	8.7
MH	lower M3 tooth	mature	sin.						24.3	8.9
MH	lower M3 tooth	mature	sin.						24.5	8.2
MH	lower M3 tooth	mature	dex.						25.0	9.0
LH	lower M3 tooth	adult	dex.						22.8	8.3
LH	lower M3 tooth	adult	sin.						23.0	8.2
LH	lower M3 tooth	adult	dex.						23.7	8.5
LH	lower M3 tooth	adult	dex.						24.4	8.4
MH	axis	mature		63.1	50.0					
H-U	axis	mature			45.5					
MH	scapula	adult	dex.					19.2	20.1	30.3

MH	scapula	mature	sin.				19.3	21.1	32.5
MH	scapula	mature	dex.				21.5	22.1	32.2
MH	scapula	mature	dex.				22.0	23.7	34.5
MH	scapula	mature	sin.				24.3	24.6	36.3
MH	humerus	mature	dex.					25.7	23.5
MH	humerus	adult	dex.					26.5	22.8
MH	humerus	adult	sin.					26.6	22.6
MH	humerus	adult	dex.					29.2	25.0
MH	humerus	mature	sin.					29.4	23.6
MH	humerus	adult	sin.					29.9	26.2
MH	humerus	mature	sin.					29.9	23.7
LH	humerus	adult	sin.					29.5	25.9
H-U	humerus	mature						28.7	25.8
H-U	humerus	mature	sin.					31.4	26.5
MH	radius	subadult	dex.	25.1	14.1				
MH	radius	adult	dex.	29.1	15.1				
MH	radius	adult	sin.	29.5	15.8				
MH	radius	subadult	dex.					28.9	19.8
MH	radius	adult	sin.					29.6	19.7
LH	radius	subadult	dex.					28.2	20.0
H-U	radius	mature	dex.	32.5	17.5				
H-U	radius	adult	sin.					31.5	21.9
MH	metacarpus	adult	sin.	23.2	16.0	14.1	9.5		
MH	metacarpus	mature	dex.	23.2	16.1				
MH	metacarpus	mature	sin.					25.1	16.5
U	metacarpus	mature	sin.	24.8	18.2				
MH	femur	adult	dex.					32.5	37.5
MH	femur	adult	sin.					33.2	39.1
MH	femur	adult	dex.					34.0	41.5
LH	femur	subadult	dex.					39.2	45.1
MH	tibia	adult	sin.					23.1	17.2
MH	tibia	adult	sin.					25.1	19.1
MH	tibia	adult	sin.					25.2	19.8
MH	tibia	adult	dex.					26.1	20.8
MH	tibia	adult	dex.					26.1	20.3
MH	tibia	adult	dex.					28.4	22.5
MH	tibia	mature	sin.					28.9	20.8
MH	tibia	mature	sin.					30.0	22.2

LH	tibia	juvenile	sin.						26.9	22.5
LH	tibia	adult	sin.						27.1	22.4
LH	tibia	adult	dex.						27.5	22.8
H-U	tibia	adult	sin.						21.8	20.8
H-U	tibia	adult	sin.						25.0	21.8
MH	astragalus	mature	dex.	25.5	24.2				15.6	14.2
MH	astragalus	mature	dex.	26.5	25.2				17.8	15.5
MH	astragalus	adult	sin.	26.8	25.7				18.2	15.4
MH	astragalus	adult	sin.	26.9	24.8				16.9	15.2
MH	astragalus	adult	dex.	27.2	25.8				17.0	15.5
MH	astragalus	mature	dex.	27.2	26.1				17.2	15.1
MH	astragalus	adult	sin.	27.5	25.8				18.6	18.3
MH	astragalus	adult	sin.	27.8	25.9				18.8	16.5
MH	astragalus	mature	dex.	27.8	26.0				17.5	15.6
MH	astragalus	adult	dex.	27.8	26.1				18.7	16.5
MH	astragalus	mature	dex.	30.7	28.9				19.6	17.9
LH	astragalus	adult	dex.	26.9	25.2				17.2	15.0
LH	astragalus	adult	dex.	27.8	27.1				17.8	16.1
LH	astragalus	adult	dex.	28.1	25.9				17.6	15.8
LH	astragalus	adult	dex.	28.3					19.1	14.9
MH	calcaneus	mature	sin.	55.1					22.5	22.2
MH	calcaneus	mature	dex.	59.9					24.2	24.0
MH	metatarsus	mature	sin.				12.0	9.7	24.2	16.5
MH	metatarsus	adult	dex.						24.5	16.3
LH	metatarsus	adult	dex.		19.4	18.2				
Goat										
LH	axis	subadult			37.8					
LH	axis	adult			44.9					
LH	axis	adult			63.3					
MH	humerus	mature	dex.						30.2	25.5
MH	humerus	mature	sin.						31.7	26.5
LH	humerus	mature	dex.						30.0	27.5
LH	humerus	mature	dex.						30.1	26.2
MH	radius	mature	sin.		34.8	16.8				
MH	metacarpus	mature	sin.						27.2	16.5
EH	femur	mature	sin.						35.2	40.5
U	tibia	mature	sin.						30.4	23.5
MH	astragalus	adult	dex.	29.5	29.2				17.4	16.2

LH	astragalus	adult	dex.	29.9	28.7				20.2	16.7
U	astragalus	mature	sin.	29.9	29.0				18.8	17.2
Pig					*Ect*		*Ent*			
LH	frontal	mature			63.2		52.6			
MH	frontal	adult			56.0		44.5			
MH	frontal	adult			57.8		44.5			
MH	lower M3 tooth	mature	sin.						33.1	18.2
LH	lower M3 tooth	mature	dex.						28.5	18.7
LH	lower M3 tooth	mature	dex.						29.5	18.8
LH	lower M3 tooth	mature	dex.						31.5	16.8
MH	humerus	adult	dex.						35.1	
EH	radius	mature	dex.		26.5	17.8				
MH	radius	neonate	sin.	38.2						
MH	radius	adult	dex.		25.8	17.1				
MH	radius	adult	dex.		26.9	19.3				
MH	radius	adult	dex.		28.3	20.1				
MH	radius	adult	sin.		28.5	18.9				
MH	radius	adult	sin.		29.3	19.1				
LH	radius	adult	sin.						31.7	24.1
MH	tibia	mature	sin.						28.1	23.5
U	tibia	subadult	sin.						30.0	24.5
MH	astragalus	adult	dex.	40.6	39.0				22.2	20.7
U	astragalus	mature	sin.	42.4	37.8				23.2	20.1
Dog										
MH	calcaneus	mature	dex.	37.5						
H-U	metatarsus III	mature	sin.	63.2						
Wild ass										
U	metacarpus	mature	sin.						35.2	27.2
MH	phalanx media	mature	sin.	36.8	38.9	35.2			38.2	
H-U	phalanx distalis	mature	dex.	45.5	52.2	20.5				
H-U	acetabulum pelvis	mature	dex.		58.8					
H-U	metatarsus	mature	sin.						37.5	30.5

Gazelle										
MH	scapula	mature	dex.					14.5	20.5	27.0
MH	humerus	mature	sin.				13.6	16.2	28.5	24.1
MH	humerus	mature	sin.						27.2	24.8
LH	femur	mature	dex.		39.2	19.5				
U	tibia	mature	dex.		34.2	39.1				
U	tibia	mature	sin.						22.0	18.5
MH	astragalus	mature	sin.	36.9	25.1				15.3	14.9
LH	astragalus	adult	dex.	26.3	24.8				15.8	14.2
LH	astragalus	adult	dex.	26.5	25.3				17.2	14.1
U	astragalus	mature	sin.	24.4	22.5				14.2	13.2
U	astragalus	mature	dex.	26.0	23.2				15.9	14.1
MH	metatarsus	mature	dex.						23.1	16.4
Brown hare										
H-U	humerus	mature	sin.		14.5	18.2				

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Chapter 8

Prehistoric Molluscan Remains from Tell Aqab, Northeastern Syria

Catriona Pickard

A small but archaeologically important molluscan assemblage was recovered from Halaf and Ubaid contexts (ca. 6th to early 5th millennium BC) at Tell Aqab in Syria. Five distinct taxa were identified; the majority of the molluscs comprise freshwater mussels (unionids) and large terrestrial snails (Helix spp.), both of which were likely collected as foods. By contrast, the remains of two species of marine shells, nassa snail (Nassarius [Plicarcularia] circumcinctus) and painted topshell (Calliostoma zizyphinum) from Middle and Late Halaf period contexts attest to the use of shell as personal adornment or ornament, and moreover point to the existence of long-distance exchange networks.

Introduction

This paper presents an analysis of a hitherto unexamined assemblage of molluscs (NISP=185, total weight=434.7 g) recovered from Tell Aqab, northeast Syria. Despite the relatively modest size of the assemblage and the limited range of taxa represented, the shells are significant, attesting to long distance exchange networks.

Archaeological background

The Late Neolithic and Early Chalcolithic periods in northern Syria are characterised by the Halaf and Ubaid cultures. Tell Aqab is situated on the northern edge of the Khabur Plain near the headwaters of the Khabur River, 6 km north of Amuda in Jezirah Province, Syria (Fig. 8.1). Occupation at the site began in the Early Halaf period and continued through into the Ubaid period to *ca*. 3,800 BC (Davidson 1981); the site was abandoned before the end of the Ubaid period in this region. This well-stratified mound site, with approximately 12 m of occupation deposits, was excavated over two field seasons from 1975 to 1976 (Davidson and Watkins 1981). Three trenches (1–3) were excavated on the north side of the site from the mound base to the point of highest elevation (*i.e*. a stepped section) to determine the site stratigraphy. A further trench (4) was placed on the south face of the mound, an area with the greatest surface evidence for Ubaid occupation, to examine stratigraphy and the Halaf-Ubaid transition in this zone of the site (Davidson and Watkins 1981; Fig. 8.2). Radiocarbon

dates obtained from cereal grains from two contexts at Tell Aqab place the Late Halaf context, Aqab 212, to 5,579–5,350 cal BC (AA-30498, 6,575±55 BP) and the earliest Ubaid context, Aqab 4.19, to 5,266–4,995 cal BC (AA-30506, 6,215±55 BP).

Fig. 8.1. Tell Aqab location map.

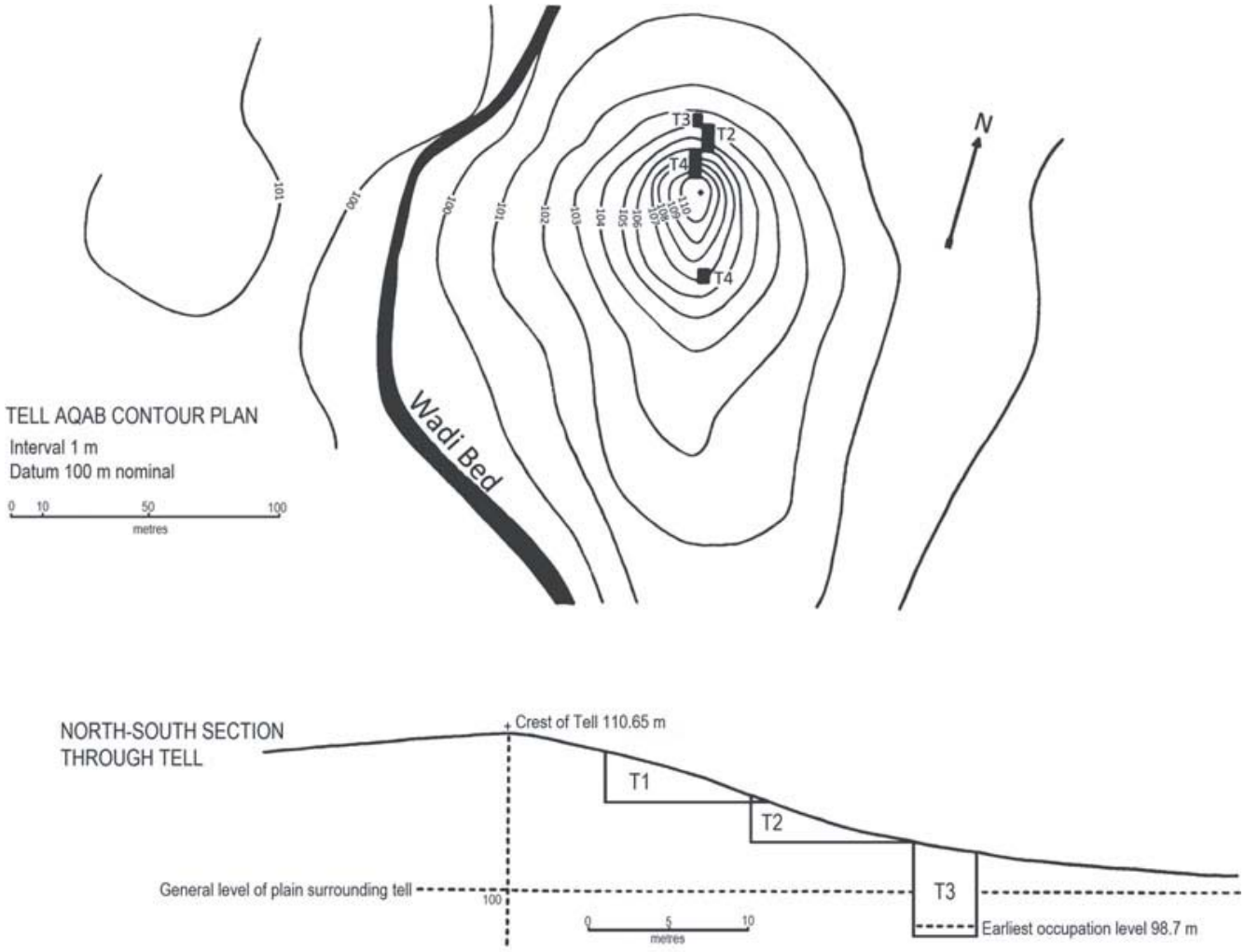

Fig. 8.2. Contour plan and section of Tell Aqab mound with location of excavated trenches (T1–T4) indicated.

The principal finds at Tell Aqab mirror those of other "western" Halaf sites as well as those of "eastern" Halaf sites in northern Iraq. Mud-brick and pisé circular buildings with an open courtyard characterised the Halaf period occupation, while mud-brick rectangular structures were typical of Ubaid period settlement (Davidson and Watkins 1981). Lithic tools, predominantly of obsidian, are represented by retouched and unretouched blades as well as burins and end-scrapers (Davidson and Watkins 1981). Personal adornments and other non-utilitarian artefacts were most abundant in later Halaf and Halaf-Ubaid transition period contexts and include polished stone and obsidian beads, polished stone miniature vessels and seal pendants, several baked-clay female figurines some of which are painted, as well as a painted clay model of a bull's head (Davidson and Watkins 1981).

A large assemblage of pottery sherds was recovered. In the earliest occupation levels deep straight-sided vessels painted with simple geometric designs, round-based "cream bowl" forms, squat jars with flaring necks, and unpainted straw-tempered burnished wares are abundant. These forms are largely, or in the case of the cream bowl form completely, replaced in the middle Halaf by more complex forms and decoration such as *Trichterrandbecher* vessels and polychrome wares. In the later Halaf phase new forms including shallow flat-based bowls with out-curved rims and disc-based bowls appear for the first time, while polychrome vessels become more common. Similar Halaf pottery

vessels are known from Chagar Bazar and Tell Arpachiyah, both in Iraq. Simple hemispherical bowls and those with in-curving rims typical of Northern Ubaid painted wares dominate the Ubaid period pottery assemblage at Tell Aqab (Davidson 1981; Davidson and Watkins 1981).

Mollusc identification and quantification

All excavated deposits from Tell Aqab were sieved through a 10 mm mesh and retents were sorted to recover faunal remains (Bartosiewicz 2016), including molluscs (Davidson and Watkins 1981). Remains of terrestrial and aquatic molluscan species were recovered from each of the four trenches excavated in the 1975 and 1976 field seasons. The molluscan remains were identified by comparison to those held in the reference collections of Archaeology at the University of Edinburgh and the National Museums of Scotland, and also with the use of appropriate identification keys.

Relative species abundance was determined from Minimum Number of Individuals (MNI), Number of Identifiable Specimens (NISP) and shell weight. MNI was calculated for gastropods from the total number of apices of each species, and for bivalves from the larger count of the total left and total right valve umbo for the entire assemblage (see Claassen 1998 and Marshall and Pilgram 1993 for discussion of the analytical worth of the various quantification methods used in archaeomalacology).

Aquatic taxa

Three aquatic taxa have been identified among the Tell Aqab molluscan remains: swollen nassa snail (*Nassarius [Plicarcularia] circumcinctus*, Adams 1852), painted topshell (*Calliostoma zizyphinum*, Linnaeus 1758) and freshwater mussel (Unionoida).

Freshwater taxa

Freshwater mussels (Unionoida) dominate the shell assemblage recovered at Tell Aqab comprising 98.4% of the assemblage by NISP (n=182), 90% by MNI (n=27), and 98.6% by weight (Table 8.1).

The preservation condition of the Unionoida (*i.e*. Unionidae/Magaritiferidae) shells is moderate to poor: the periostracum is largely lost and the shells have a chalky consistency. Furthermore, the remains are highly fragmented. Attribution to species is further complicated by the taxonomic diversity debate between "lumpers" who argue that Palearctic unionids are represented by 45 species, and "splitters" who identify 156 species (see Graf and Cummings 2007 for discussion). Only three almost complete valves of unionids were recovered: Figure 8.3; these can be attributed to the *Unio* genus. Graf and Cummings (2007) recognize four species of *Unio* in the Middle East; *Unio crassus*, *Unio mancus*, *Unio terminalis* and *Unio tigridis*. The near complete valves from Tell Aqab have an elongated oval form, pronounced umbone positioned close to the anterior edge, rounded anterior and sub-triangular posterior with a slight "rostrum", and strong cardinal tooth. Their form and dimensions (Table 8.2) are consistent with *U. tigridis/terminalis* (Bourguignat 1853; Şereflişan and Yilmaz 2011). The height of the *U. crassus* shell is generally less than half of its length and the shell radius is usually thick. *U. tigridis* is endemic to the Tigris (Bourguignat 1853; Haas 1969), whereas, the closely related species *U. terminalis*, which is distinguished from *U. tigridis* by slight differences in bivalve thickness, hinge structure, rostrum prominence and umbone position (Bourguignat 1853), likely inhabits different river systems (Mienis 2013). While this supports attribution to *U. tigridis*, species level identification of the Tell Aqab specimens is non-trivial as (i) the condition of the valves is relatively poor, and (ii) wide

intra-species variation in *Unio* shell form and size have been observed (Hochwald 2001; Plaziat and Younis 2005, pl. 2, figs 1–2 and 5). Given the fragmentary nature of most of the Unionoida shells recovered at Tell Aqab more than one and possibly several species may be represented.

Table 8.1. Aquatic mollusc species from Tell Aqab. Cultural affiliation/chronology of the shell samples was determined from the description of the excavated trenches and levels provided in Davidson and Watkins (1981). As the find contexts of some of the shell remains were recorded by trench number only, and given the small size of the assemblage, no attempt was made to compare species representation by cultural period (source: American Anthropologist 96, 97–126).

Cultural affiliation	Taxon (NISP)			Taxon (MNI)		
	Unionoida	*N. circumcinctus*	*C. zizyphinum*	Unionoida	*N. circumcinctus*	*C. zizyphinum*
Early Halaf	14			3		
Middle Halaf	60	1		9	1	
Late Halaf	4	1	1	–	1	1
Halaf/Ubaid transition	1	–				
Ubaid	4					
Unspecified	99			15		
Total	**182**	**2**	**1**	**27**	**2**	**1**

Marine species

Two specimens of *N. circumcinctus* and one of *C. zizyphinum* were recovered from Middle and Late Halaf contexts at Tell Aqab (Figs 8.4 and 8.5). Both are obligate marine species.

Nassarius spp. and *C. zizyphinum* are relatively commonplace on the shores of the Mediterranean. Carnivorous *Nassarius* spp. generally lie buried in soft substrates except when feeding (Crisp 1978). Although carnivorous species are generally less abundant than herbivorous species the shells of nassa snails can be readily collected empty along the shoreline. *Nassarius* spp. are generally a small shelled species (adults reaching a length of 15–20 mm) with relatively little meat/flesh and not considered an important food species.

Fig. 8.3. Examples of near complete Unionoida valves recovered from Tell Aqab.

Table 8.2. Dimensions of intact valves at Tell Aqab.

Context	*Taxon*	*R/L valve*	*Length (mm)*	*Height (mm)*
2.1 (Halaf)	*Unio*	R	67.6	35.0
T4.8 (Halaf or Ubaid)	*Unio*	L	70.9	39.9
Middle Halaf	*Unio*	L	64.6	32.4

By contrast *C. zizyphinum* generally lives on seaweed on rocky shores from the sub-littoral region to depths of 300 m in the UK (Hayward and Ryland 1990), although its ecological preferences in the Mediterranean have not been recorded. It is a relatively small species attaining maximum height of 34 mm (Crothers 2001).

Discussion of the aquatic species

Freshwater mussels are commercially important food species (*e.g*. Anthony and Downing 2001) and are also widely exploited for their nacreous, mother of pearl, inner surface (*e.g*. Şereflişan and Yilmaz 2011). Shell was also used as temper in pottery production in the Ubaid period at Tell al-'Abr, northeastern Syria (Weiss 1991). Exploitation of shellfish, likely for food and possibly as raw material, is evident at a number of pre- and proto-historic sites situated near the Tigris and its tributaries and elsewhere in the Middle East. At the Samarran period (6th millennium BC) site of Tell es-Sawwan, Iraq, the freshwater mussel species *U. tigridis* and *Pseudodontopsis euphraticus* were heavily exploited (Flannery and Wheeler 1967). Freshwater molluscs are reported in small quantities at several Halafian sites including Sabi Abyad and Umm Qseir in northern Syria (Akkermans 1987; Zeder 1994). *U. crassus* and *U. tigridis* were identified both at Girikihaciyan and at Çavi Tarlası in southeastern Anatolia (McCardle 1990; Schäfer and Boessneck 1988). The remains of freshwater molluscs are also reported from Ubaid contexts at Kenan Tepe, SE Turkey (Parker *et al*. 2008). Shell was also widely used in ancient Mesopotamia as a decorative inlay material (Moorey 1999). Although it is likely that the freshwater shellfish were collected for food and/or as a source of raw material at Tell Aqab, Courty (1994) indicates that settlement sites in the Jezirah region during the Halaf-Ubaid-early Uruk period from 7,000–5,000 BP were subject to inundation. It is possible, therefore, that Unionoida shells were deposited at certain sites during episodic/occasional flood events.

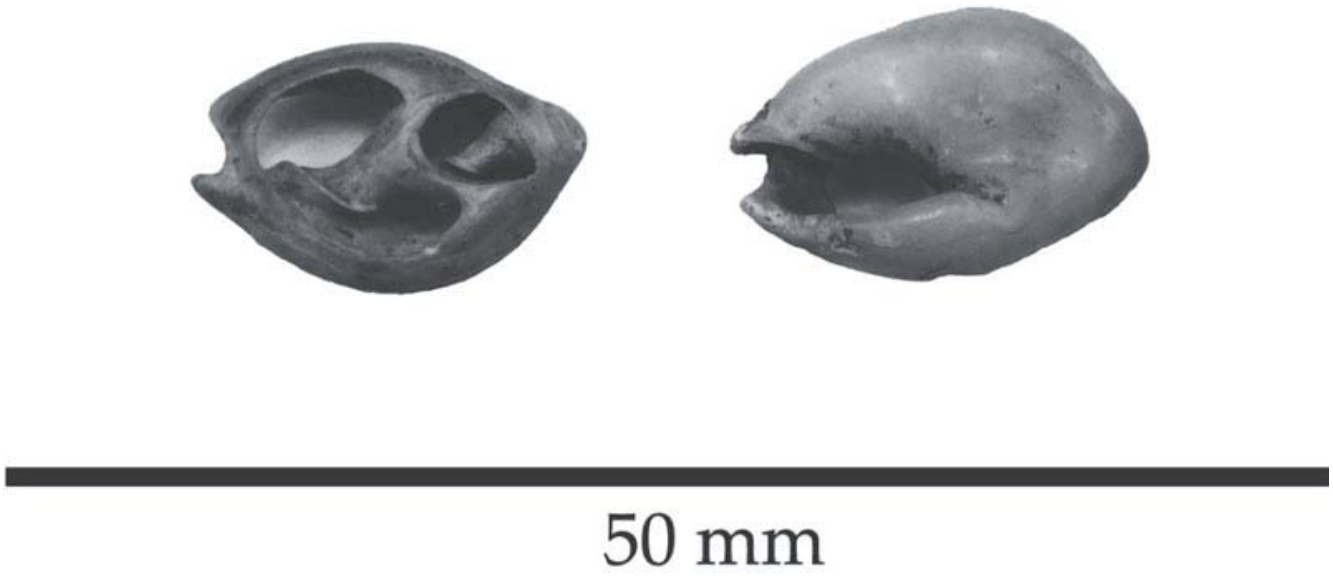

Fig. 8.4. Nassarius circumcinctus *specimens recovered from Tell Aqab*.

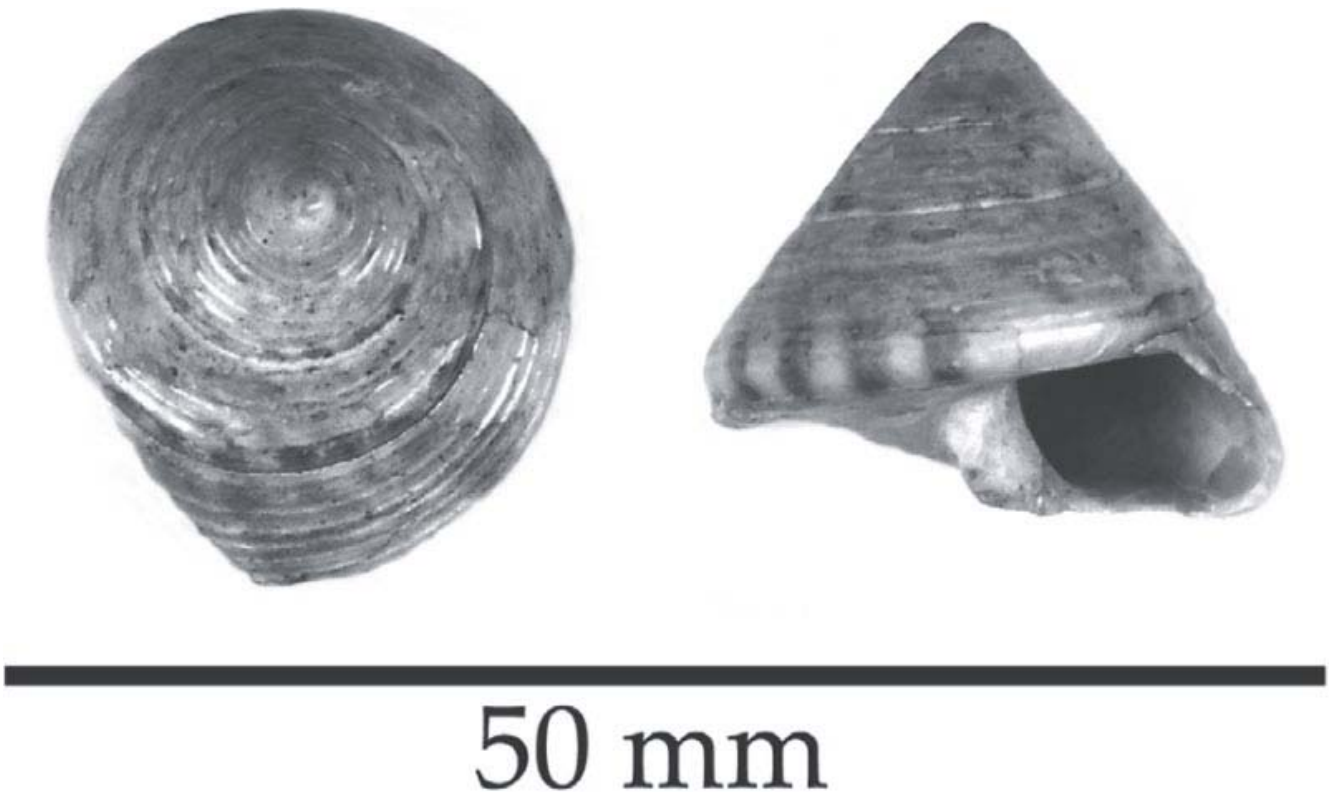

Fig. 8.5. Calliostoma zizyphinum *specimen recovered from Tell Aqab*.

The ceramic remains from Tell Aqab hint at regional trading links. Neutron activation analysis and characterisation of the Tell Aqab pottery was interpreted as indicating that a large proportion of the pottery was non-local and that there was a high level of trading activity with the nearby production centre of Chagar Bazar, located some 15 km to the south of Tell Aqab (Davidson 1981; although see Galbraith and Roaf 2001 for a re-evaluation of this evidence). The presence of marine shells at Tell Aqab attests to links further afield, between northeastern Syria and coastal regions. Tell Aqab is situated *ca*. 550 km from the Mediterranean Sea and *ca*. 750 km from the Black Sea. In a recent survey of the distribution of shellfish in the "Seas of Turkey" neither *C. zizyphinum* nor *N. circumcinctus* were found to be present in the Sea of Marmara or the Black Sea but both species were present on the shores of the Mediterranean/Aegean Seas (Demir 2003).

Although neither *C. zizyphinum* nor small *Nassarius* species are widely consumed as food, both have long been used as raw material for adornments and appear to have held symbolic significance. *Nassarius* species shells (such as the closely related species *N. circumcinctus, N. gibbosulus* and *N. kraussianus*) and other small "basket-shaped" species have been prized as adornments or ornaments in Africa and the Levant from the Middle Palaeolithic (*i.e*. the Middle Stone Age of Africa) onwards (Bar Yosef Mayer *et al*. 2009; Bouzouggar *et al*. 2007; d'Errico *et al*. 2009; Kuhn *et al*. 2009; Stiner 2003; Vanhaeren *et al*. 2006). Many specimens recovered from archaeological contexts have perforations ground into the shell likely to facilitate suspension and van Regteren Altena (1962) suggested that such shells may have been attached to clothing. Both of the *N. circumcinctus* specimens recovered at Tell Aqab are perforated and these shells may have been intentionally ground for suspension/adornment.

The *C. zizyphinum* specimen from Tell Aqab was intact and well preserved with some colouration of the periostracum still visible. Although less commonly recovered from early prehistoric archaeological contexts than basket-shaped shells, highly decorative topshells (Trochidae) have also

been collected for use as ornaments since the Palaeolithic (*e.g*. Stiner *et al*. 2013).

Numerous annular shell beads, shell plaques and "buttons" and a single perforated pearl have been recovered at the Ubaid-related site H3, As-Sabiyah, which is located on the coast of northern Kuwait; however relatively few finds of shell artefacts have been documented at Mesopotamian sites (Carter and Crawford 2002). Shells artefacts have been reported in small quantities from Late Neolithic and Early Chalcolithic sites in northern Syria (Akkermans and Schwartz 2003). For example, cowrie shell beads were recovered at Tell Arpachiyah (Campbell 2000). Shell beads were also documented at Halafian Yarim Tepe II (Merpert and Munchaev 1987). Further Halaf/Ubaid period finds of shell artefacts include a shell ring from Tell Oueilli (Huot 1992) and a shell seal stamp from Domuztepe (Campbell 2009).

Terrestrial taxa

A minimum of two terrestrial taxa were identified (Table 8.3). The terrestrial assemblage is dominated by *Helix* spp. (98.1% by MNI, N=52; Fig. 8.6). One specimen of a near complete and several fragmentary *Xeropicta derbentina* shells were also recovered.

Xeropicta derbentina, Krynicki 1836, is one of the most common terrestrial mollusc species in the Near East (Schütt 2001; Şeşen and Schütt 2000). A small, relatively thin-shelled species, with adults ranging from 12–20 mm in diameter, it is unlikely to be directly related to past human activity at Tell Aqab and was likely naturally-deposited.

The *Helix* sp. specimens range from 22–28 mm in maximum diameter with an average diameter of 25.2±1.6 mm (see Table 8.4 and Fig. 8.7 for the shell dimensions and the distribution of the *Helix* sp. shell diameter) with four or four and a half convex whorls and a completely sealed umbilicus. The shells are creamy-white in colour with faint brown spiral bands, coarse growth ridges, regular last turn and high peristome, *i.e*. consistent in form and colour with one of the smaller edible *Helix* species, such as *Helix asemnis*, Bourguignat 1860 or *Helix dickhauti*, Kobelt 1903 (Kebapçi *et al*. 2012; and see identification key in Yildirim *et al*. 2004). *H. dickhauti* may be distinguished from *H. asemnis* in modern specimens through differences in colour and band pattern, and potentially by general aperture shape, but have similar shells when weathered (Kebapçi *et al*. 2012). *H. asemnis* is documented to grow up to 40±5 mm in diameter. The maximum diameters of *H. dickhauti* shells are documented as smaller than those of *H. asemnis* (Schütt 2001). The *Helix* specimens from Tell Aqab have relatively small diameters consistent with *H. dickhauti* attribution. However, ecotypical variation is observed in *H. asemnis* populations (Kebapçi *et al*. 2012). The presence of a number of heavily ribbed shells as well as specimens with "smoother" shells suggests that both species are represented (*cf*. Kebapçi *et al*. 2012). Both species are generalists, can be found in a wide range of open habitats, and are distributed throughout South Turkey and North Syria (*e.g*. Ceylan *et al*. 2008; Yildirim *et al*. 2004).

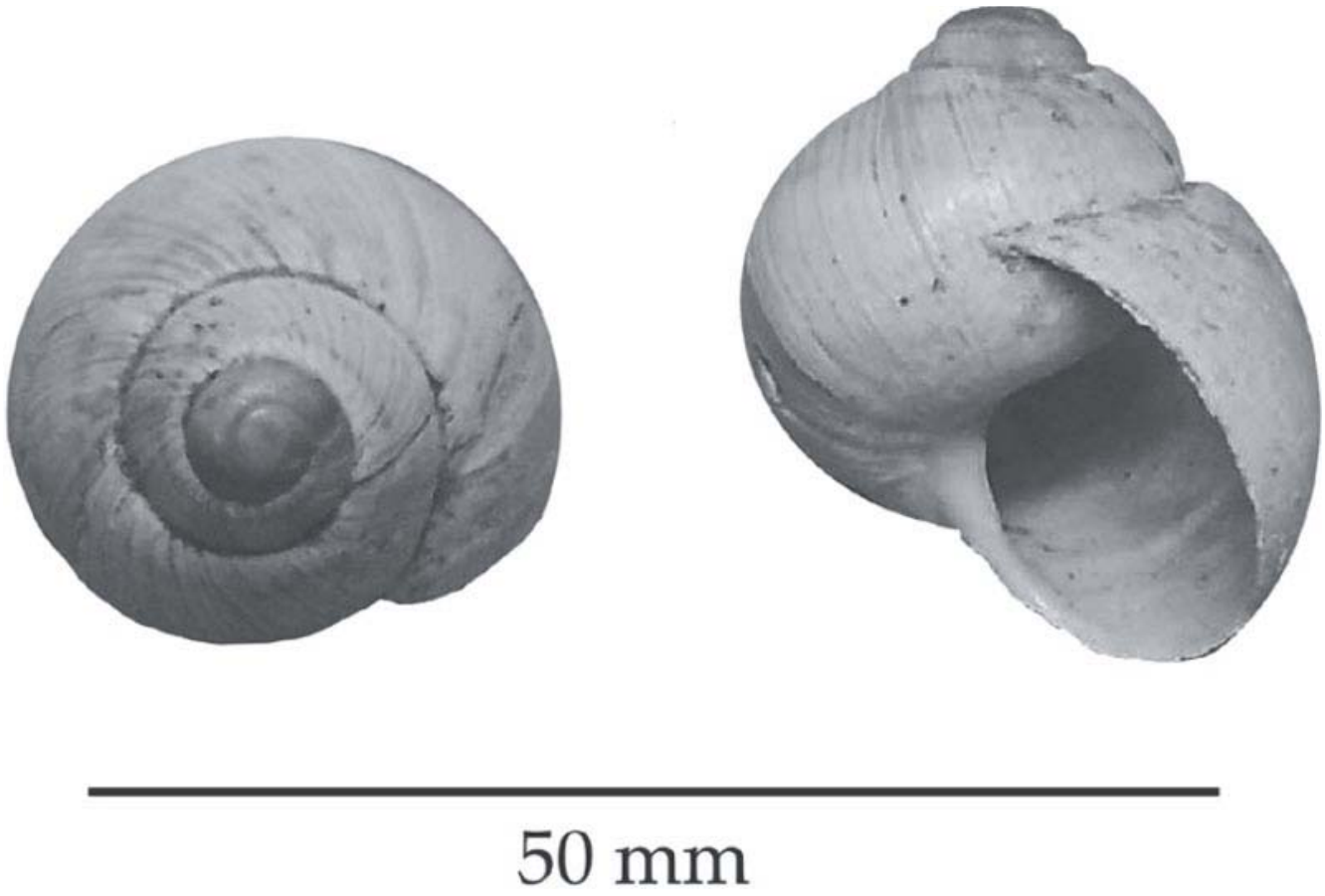

Fig. 8.6. Example of Helix *sp. shell recovered from Tell Aqab.*

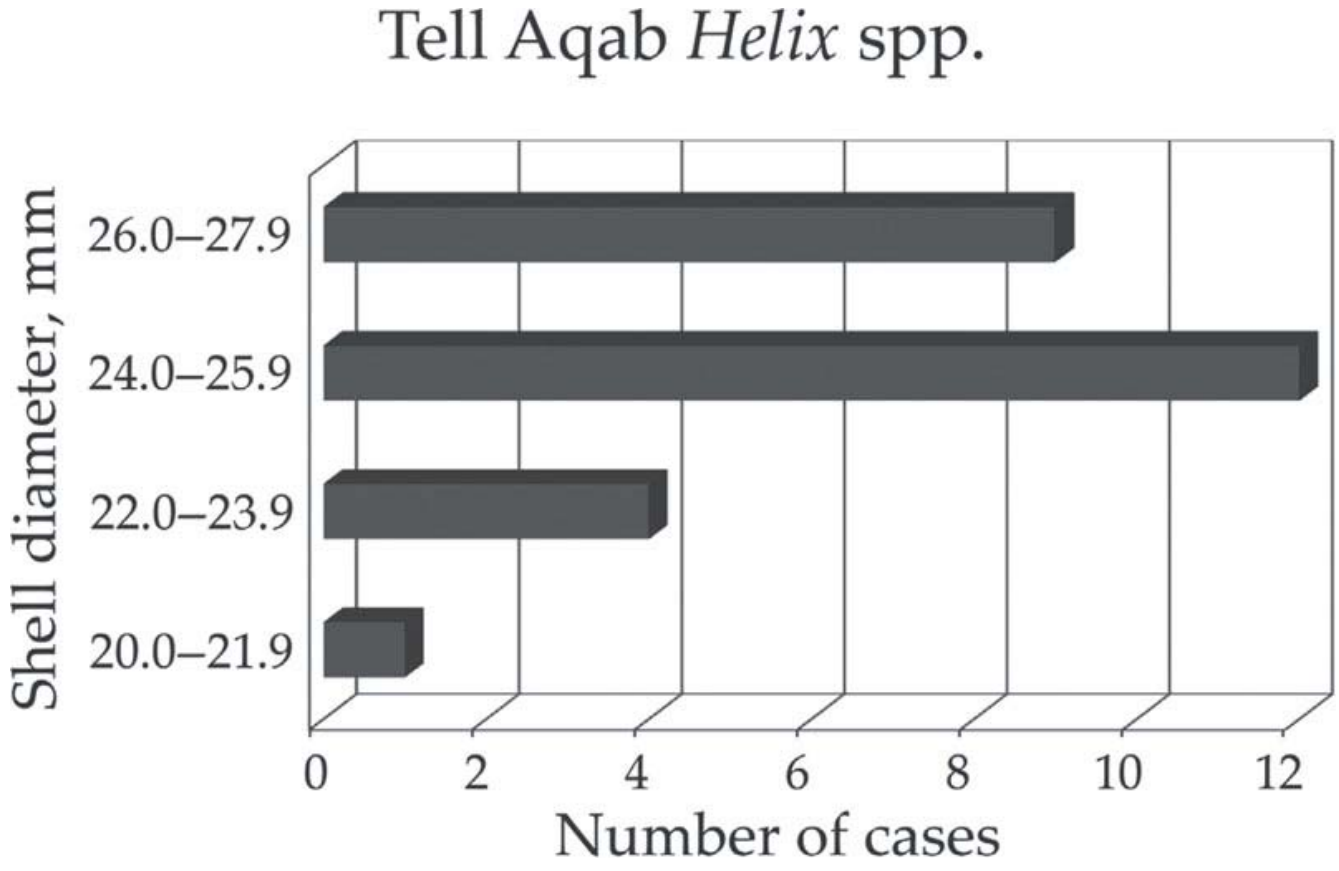

Fig. 8.7. Size distribution of maximum diameter of Helix *spp. shells.*

Table 8.3. Terrestrial molluscan species from Tell Aqab. (American Anthropologist 96, 97–126)

	Taxon (NISP)			Taxon (MNI)		
Cultural affiliation	*H. asemnis/dickhauti*	Helicidae indet.	*X. derbentina*	*H. asemnis/dickhauti*	Helicidae indet.	*X. derbentina*
Middle Halaf	4			3		
Halaf/Ubaid transition	1			–		
Unspecified	48	3	10	43	–	7
Total	53	3	10	46	0	7

Table 8.4. Dimensions of Helix *sp. at Tell Aqab.*

Context	*Height (mm)*	*Width (mm)*	*Context*	*Height (mm)*	*Width (mm)*	*Context*	*Height (mm)*	*Width (mm)*
1.1	31.1	n/a	1.1	26.2	24.0	1.14	30.3	26.1
1.1	29.0	27.5	1.1	30.7	26.1	1.15	30.6	26.1
1.1	27.5	25.8	1.1	28.4	25.6	1.15	31.7	26.7
1.1	26.8	27.5	1.1	25.1	22.2	1.15	28.0	23.7
1.1	26.3	26.3	1.1	30.4	24.3	1.15	30.2	26.6
1.1	30.0	24.9	1.1	27.4	24.7	1.15	28.0	24.3
1.1	28.4	25.7	1.1	24.4	20.9	2.1	27.6	23.7
1.1	25.4	23.4	1.6	27.2	25.6	2.10	29.6	26.5
1.1	29.5	25.7	1.14	29.4	25.3	2.10	28.7	25.0

Larger species of terrestrial snails including *H. asemnis*, and in particular *Helix aspersa* and *Helix pomatia*, are commercially farmed today and have been exploited as a food resource since prehistoric times (*e.g.* Lubell 2004; Yildirim *et al*. 2004). One fragment of *Helix* sp. shell recovered at Tell Aqab was discoloured in a manner consistent with heating. This may represent intentional heating or cooking of *Helix* snails or reflect pre- or post-depositional incidental heating. It is therefore possible that the *Helix* snails were collected as food at Tell Aqab. However, there are no definitive indicators for the human use of this species. As there are a number of indigenous synanthropic *Helix* sp. in the Jezireh region the presence of these specimens at Tell Aqab may be incidental to, or may even post-date, Halaf-Ubaid period activity at the site.

Conclusion

Five taxa of terrestrial and aquatic molluscs were recovered from Early Halaf to Ubaid period contexts at Tell Aqab. Harvesting of freshwater mussels as food or raw material is likely, and consumption of edible land snails is possible. However of the taxa identified only two, nassa snail and painted topshell, can be definitively attributed to anthropogenic activity at the site. These marine specimens, which originated at least 550 km distant from Tell Aqab, testify to the existence of long distance exchange networks during the Halaf Ubaid period.

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Chapter 9

Preliminary Analysis of the Fauna from the Early Bronze Age III Neighbourhood at Tell es-Safi/Gath, Israel

Haskel J. Greenfield, Annie Brown, Itzhaq Shai and Aren M. Maeir

This paper describes the analysis of the zooarchaeological assemblage from the first stage of recent excavations (2004–2009) of the Early Bronze Age III neighbourhood at Tell es-Safi/Gath, Israel. The site, most of which was surrounded by a large fortification wall, is a major urban centre for the region during the EB III. Excavations of this neighbourhood demonstrate that it was characterised by a layout of houses that is common for other EB urban centres in the region, including sturdy, small multi-room houses, with a courtyard, and in few cases a small storage room. Occupants had access to long-distance and local trade goods, and used various recording methods, such as a cylinder seal and potter's marks. It has been suggested that it was probably inhabited by the emerging class of merchants. The analysis of animal remains from the neighbourhood suggest that the inhabitants largely relied upon herded domestic livestock (i.e. sheep and goats), emphasised the culling of young sheep for primary products, exploited domestic cattle and goats largely for their secondary products, hunted a variety of wild animals, and sacrificed expensive animals best known for transporting goods (domestic donkeys). These provide insight into the nature of animal exploitation strategies in a non-elite context during the period of early urbanism in the southern Levant.

Introduction

The ongoing and long-term archaeological research and excavation project at Tell es-Safi/Gath (Fig. 9.1) has revealed the presence of a significant Early Bronze (EB) occupation at the site (Maeir 2012a; Shai *et al*. 2014). While the entire EB I–III sequence is probably represented, spanning from *ca*. the second half of the fourth to the first half of the third millennia BCE – based upon the ceramic typo-chronology of the region and systematic surface survey at the site (Uziel and Maeir 2005, 2012a, 2012b), our excavation activities at the site on this period have largely concentrated on the EB III occupation (Maeir *et al*. 2011; Shai *et al*. 2012).

Initially, the research program at the site on the EB was not a major focus of the excavation team

since it was focused on the large-scale Late Bronze Age (Canaanite) and Iron Age (Philistine/Judahite) occupation. The site is most famously known as Gath of the Philistines, which according to the biblical text was the home-town of the famous Philistine giant and champion, Goliath, who was brought down by famous biblical figure of David. However, with the discovery of the significant EB occupation at the site, the opportunity arose to embark on a scientifically oriented, intensive and long-term investigation program of the EB of the site in general and of the animal exploitation strategies from a non-elite or commoner neighbourhood area in particular.

The assemblage has many advantages over other excavated assemblages from the region in that the fauna:

1. derive from only a single period – the latter half of the EB III (*ca*. 2,850–2,500 BCE);
2. derive from a series of tightly integrated absolutely and relatively dated deposits – the EB III chronology at the site is rooted in a tight sequence of high-quality radiocarbon samples;
3. derive from a single location within an extensively settled site and can be used as a reflection of a single neighbourhood's patterns of behaviour and deposition – during this period of occupation in this location;
4. derive from a series of very tightly controlled EB III spatial contexts within the neighbourhood, and for the most part derive from domestic living spaces – hence, the data allow for the opportunity to observed distinctions within and between different EB domestic complexes;
5. were systematically collected through intensive sieving; and
6. derive from deposits where geoarchaeological observations are being made, which enables reconstruction of various taphonomic processes.

As a result, we can obtain insight into the behaviour of an early urban neighbourhood through a high quality and chronologically short-term faunal assemblage. In this study, we present a preliminary assessment of faunal assemblage as a whole that has been recovered from the excavations of the later EB III neighbourhood at Tell es-Safi/Gath from 2004–2009. The more recent material is currently undergoing analysis, but analysis awaits stratigraphic data for each of the depositional contexts.

Location and nature of the site

The site is located in central Israel, in the lower reaches of the Elah valley at the point where the valley leaves the Shephelah (Judean foothills) and enters into the coastal plain. It is atop the highest prominence in the region and dominates the surrounding landscape. From its pinnacle, one can see to the Mediterranean on a clear day to the west and far into the mountains of Judea in the east. In antiquity, before the silting up of the local river and stream valleys, water probably ran year-round in the *wadi* (seasonally dry stream valley) to the north of the site. The site can easily be divided into two major parts: an upper (tell) and a lower site. The upper site is the visible part of the tell and is what stands out clearly above the surrounding countryside since it sits atop a white cliffs representing the last of the hills before the coast plain. The lower site is found in the valley bottom between the base of the tell and the edge of the *wadi* that runs along the northern face of the tell. It is most famous for its large-scale and well-preserved Iron IIA (later Philistine) occupation that was destroyed in the second half of the ninth century BCE by King Hazael of Aram Damascus, as briefly mentioned in II Kings 12:18 (Maeir 2012b, 2013).

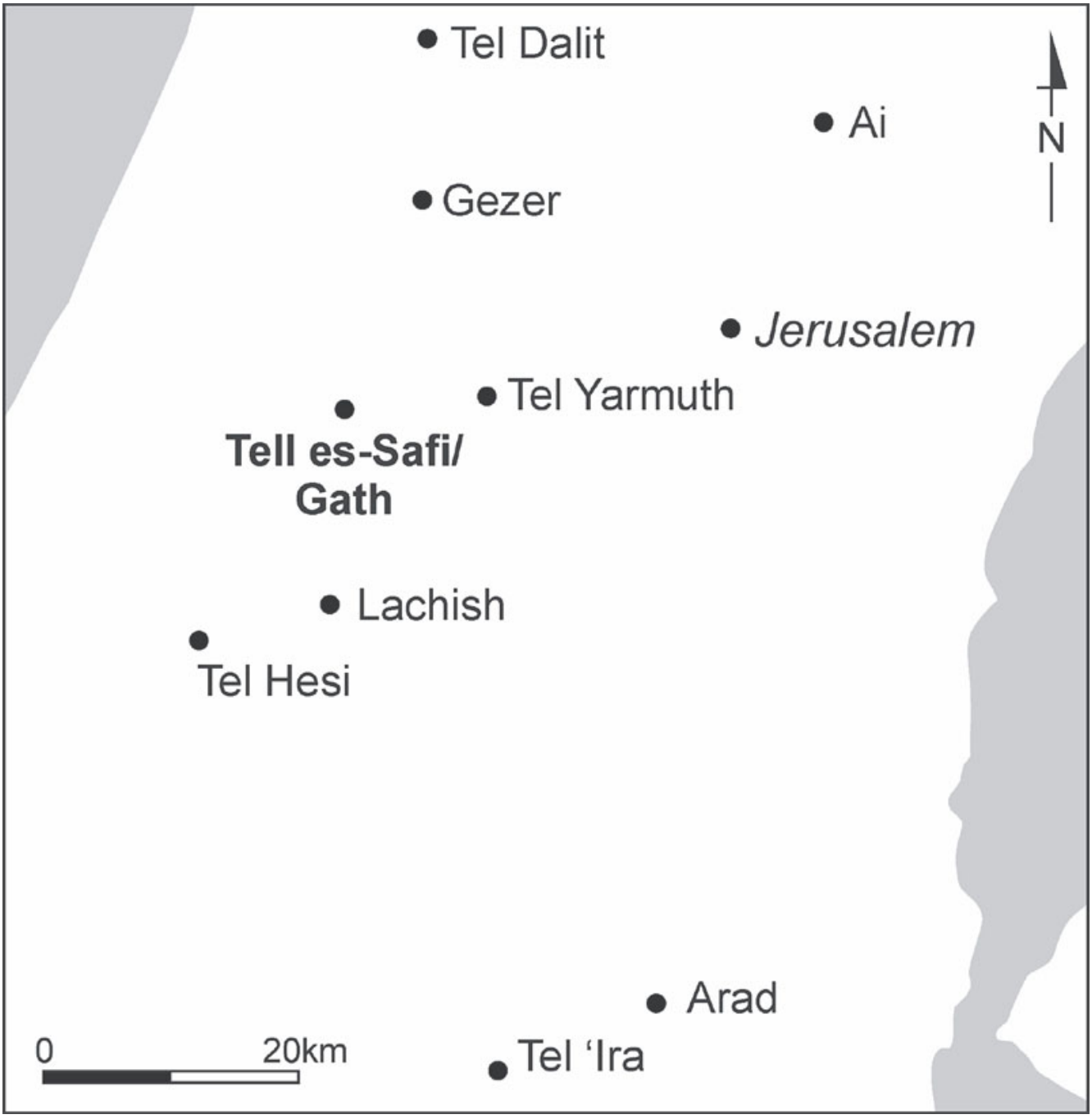

Fig. 9.1. Map showing the location of Tell es-Safi/Gath and other important EB sites in the region.

The tell is a series of thick superimposed deposits that sit atop a natural rocky outcrop that is almost U-shaped in form. At the western end of the tell, the deposits are thickest and range from the EB to the modern era. The final occupation at the site ended in 1948. The site is an Israeli national park and is under the supervision of both the Israel Nature and Parks Authority and the Israel Antiquities Authority.

Surface survey

An intensive and systematic surface survey and collection of the site was conducted at the beginning of the project. This demonstrated that there were large-quantities of EB pottery found on both the eastern and western ends of the upper tell suggesting that the site was extensively settled during the EB. The

spatial distribution of pottery suggests that the size of the site during the EB was *ca*. 24 ha (Fig. 9.2; Uziel and Maeir 2012a: 175–177). This makes it one of the largest sites for the region during the Early Bronze Age (Broshi and Gophna 1984; de Miroschedji 2009). Combined with the results of the excavations that followed, it is evident that the site played a significant role in the regional hierarchy during this period.

Nature of Early Bronze settlement

Substantial evidence has been uncovered to document that the EB settlement on the upper tell was surrounded by a large and extensive fortification system. In Area F, at the northwest end of the tell, *ca*. 250 m to the west of Area E, 20 m of the EB fortification has been exposed while being deeply buried beneath later deposits. In Area P, along the southern face and closer towards the eastern side of the upper tell, another 20 m of the EB fortification has been exposed (Shai *et al*. 2016; Fig. 9.2). In both areas, the walls are *ca*. 30–3.5 m wide with bastions. The walls discovered by the current excavations seem quite similar to a city wall discovered by the earlier British excavations (Bliss and Macalister 1902), and it is thus suggested that the various sections of this wall were part of a fortification system that encircled the summit of the EB city.

In Area A, immediately to the west of Area E, there have been several hints as to the existence of EB levels beneath the IA and LB remains. In addition to the fact that large amounts of EB pottery are found in the basal Iron Age levels in this excavation area, architectural elements dating to the late EB were excavated below the remains of an Iron I temple, on the westernmost side of Area A. Therefore, it can be assumed that the EB levels exposed in Area E continue west under the later levels in Area A. The combination of EB finds across the entire surface of the tell, fortifications toward both ends of the tell, and an extended area of occupation in the east suggest that the EB occupation extended across the entire tell (*i.e*. upper site) over an area of at least 24 ha.

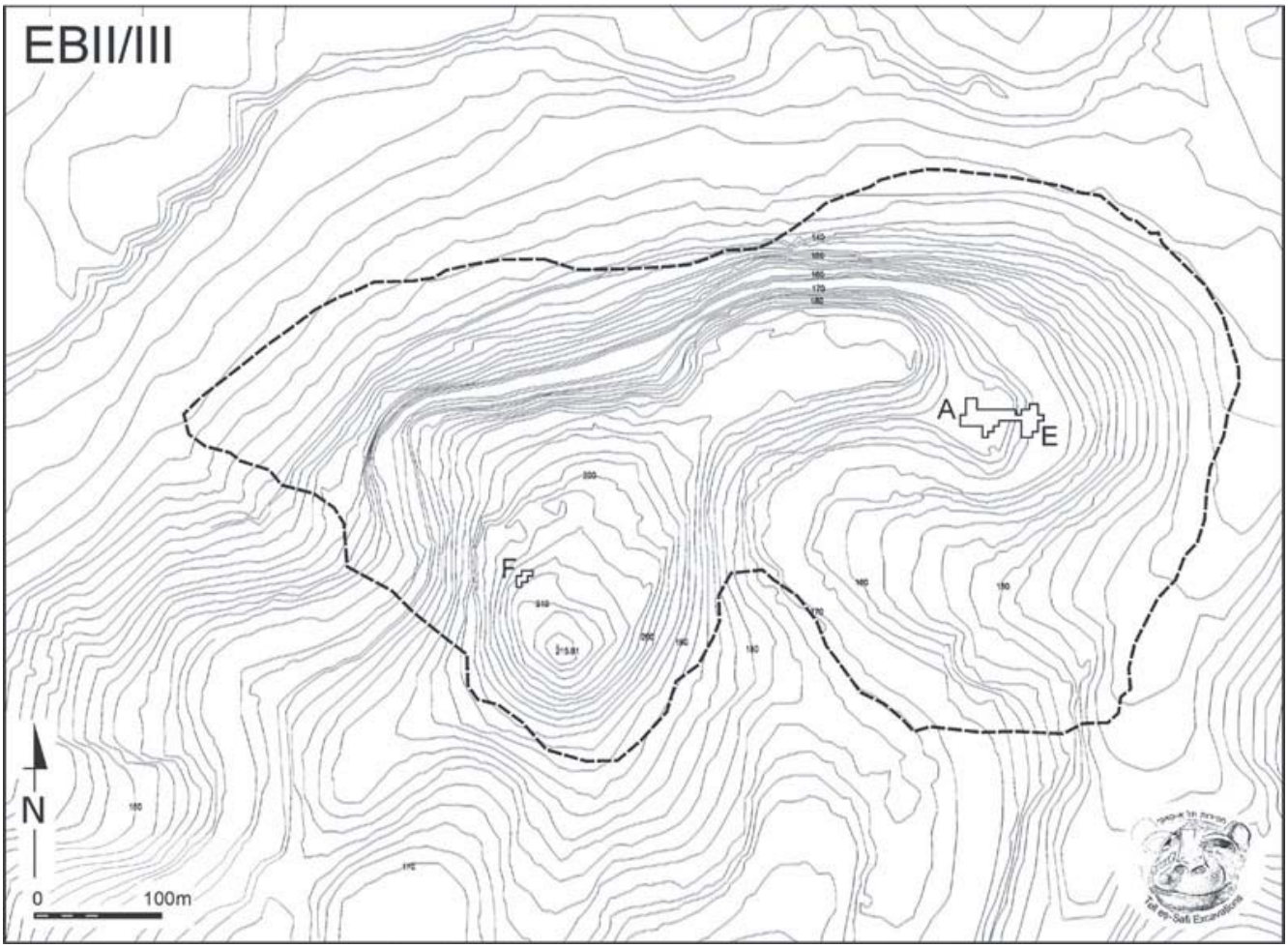

Fig. 9.2. Map of the extent of the EB at Tell es-Safi/Gath, based on the surface survey, and location of excavation areas.

The Early Bronze Age neighbourhood (Area E)

Excavations began in this area in 2000, but began to focus on the EB from 2004 onwards. Up to 2009, *ca*. 300 m sq of the EB were exposed in this area. Within this area, three stratigraphically superimposed EB horizons have been defined (Strata E5, E6 and E7), but the remains discussed in this paper derive from the uppermost E5 horizon. Stratum E5 is associated with the latter part of the EB III, E6 to the earlier part of the EB III, and E7 probably dates to the EB II (Shai *et al*. 2014). There is no evidence of destruction between the E5 and 6 horizons. Instead, the evidence leans in the direction of cultural and architectural continuity since some of the walls of the structures seem to be rebuilt along the same lines. The stone foundations of the Stratum E5 walls are constructed directly atop of the earlier mud-brick superstructures and stone foundations of E6.

The remains of a domestic neighbourhood, which includes buildings with courtyards, rooms, various installations, and an alleyway, have been uncovered associated with Stratum E5. At least four building complexes and an alleyway between them have been uncovered to date. Three of the complexes are on the east side of the alleyway and the fourth is on the west. The buildings are oriented with their long axis to northwest-southeast, and their short axis to southeast-northwest (Fig. 9.3).

All of the houses are all fairly humble abodes, with three to four courses of rough field stones laid as above-ground foundations, and a mud-brick superstructure. There appears to be two types of houses

in the neighbourhood, which are differentiated largely by stone or earthen floors and separated by a narrow alleyway. The house floors to the east of the alley are simple and earthen, while at least one of the rooms in the house to the west has a stone paving.

The area declines in elevation from northwest to southeast and the structures were built to follow the natural slope. This creates problems for the preservation of the faunal remains in the area since the seasonal rains would have torrentially coursed downhill through the open alleyway between the covered building areas.

The pottery found associated with the houses in the neighbourhood represents for the most part domestic production, storage and consumption of foods. The pottery assemblages of the three EB III sub-phases are almost identical. None of the ceramics appear to have been made far from the site, suggesting local ceramic production, even the so-called Khirbet Kerak Ware (Zuckerman *et al*. 2009; Shai *et al*. 2014).

But, by and large, between the architecture and finds, the neighbourhood appears to be the home of "lower stratum" individuals. It probably represents the residence of several middle class "merchant" families since many items of value are found in addition to many local and long distance trade goods.

Chronology

The pottery is typologically dated to the late Early Bronze Age III (Uziel and Maeir 2012b). Absolute calibrated radiocarbon dates have been determined for the E5 Stratum. All dates are reported in conventional radiocarbon years BP following international conventions (Stuiver and Polach 1977). When the dates are calibrated to ±1σ ranges, they begin by 2,850 BCE and end before 2,500 BCE, probably around 2,600 BCE (Shai *et al*. 2014). These dates correspond to the newly suggested "high" radiocarbon chronology for the EB southern Levant (Regev *et al*. 2012).

Fauna

Chronological integrity

Even though three sub-phases of the E5 Stratum have been identified, some deposits still need to be assigned to a particular sub-phase. As a result, the fauna described here derive from the stratum as a whole and are treated as a single analytical unit.

The sample was further reduced in order to ensure chronological integrity. One of the dangers of analysing remains from a multi-period tell site is that later remains, in particular, can filter into the earlier layers. For example, there are Iron Age and LBA pits and foundation trenches that cut deeply into the EB III horizon. The analysis presented here focuses on those deposits which show no evidence of later intrusions. It includes the fauna collected during the 2004–2009 excavations and are from chronologically high quality deposits.

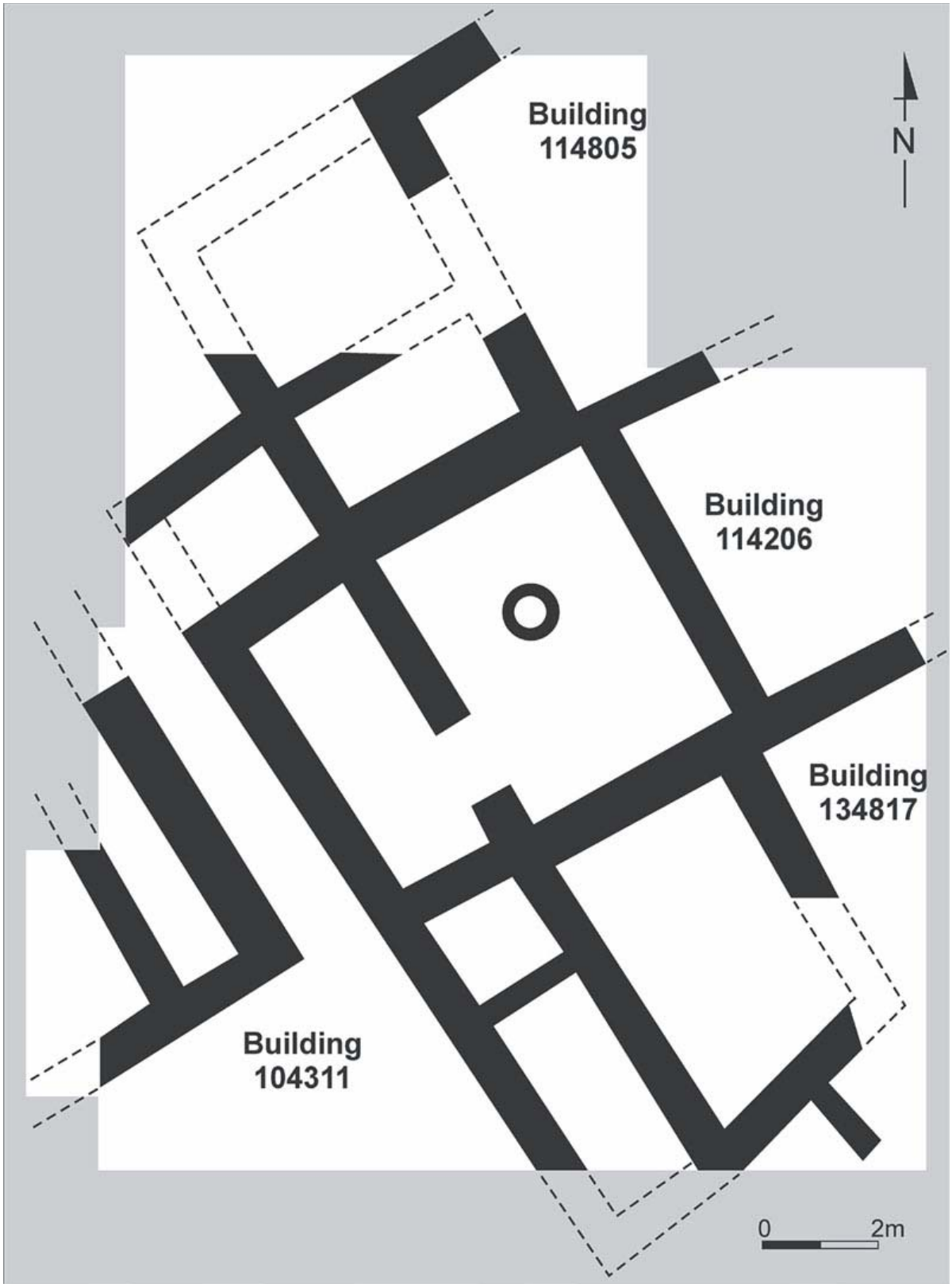

Fig. 9.3. Architectural plan of Stratum E5a–c showing the four house complexes and alleyway.

Quantification

Specimens are quantified in this report using NISP (Number of Identified Specimens). It is an extremely useful quantification measure for urban assemblages since it does not assume that any of the remains are from the same individual, while at the same time allowing the analyst to correct for visible

or inferred articulations in even smaller sample sizes (Grayson 1981; O'Connor 2000). As a result, the NISP is usually smaller than the total number of fragments, which is different from a common use of this measure as simply the number of fragments identified by the analyst. This latter version would simply be TNF (Total Number of Fragments). As will be discussed below, the TNF is not a suitable reflection of taxonomic frequency given that the remains continue to fragment over time and it does not take into account potential or real articulations. The EBA assemblage so far analysed from the E5 Stratum of Area E is 2,164 NISP. This is a moderately-sized sample, given the scale of excavation so far (*ca*. 300 m sq).

Assemblage taphonomy

The soil from the EB III horizon can be described as a sandy loam. There is a moderate amount of clay in the matrix, which holds moisture, despite the fact that the deposits lie atop an elevated rise. The amount of sand in the sediment does not appear to have heavily impacted the assemblage since most bones have their hard periosteum still intact. But the amount of clay in the EB deposits with its water retention ability have created a situation where the soil conditions are less conducive to bone preservation in comparison to the later deposits at the site. The bone readily fragments into small pieces when it is uncovered, making it more difficult to conduct analyses. This is evident from the high number of fragments with modern breaks (74.9%).

Similarly, bone integrity does not appear to be impacted by soil acidity since a relatively normal pH has been recorded for most sediments (*e.g*. 6–7). Similarly, weathering does not appear to have been a large-scale cause of bone attrition (Table 9.1). The vast majority of remains exhibited only light weathering (93.76%), with very few medium (6.05%) and even fewer with heavy weathering (0.18%).

As a result, the biggest taphonomic problem is that the structural integrity of the osteological remains bones appears to be compromised by the relatively high retention of moisture in soil. In order to avoid damage when removing osteological remains from the soil, they are left to dry slowly in the soil. Otherwise, they fragment when removed from the soil. Even if they are carefully dried in the soil, they must be placed in paper bags or cardboard boxes in order to avoid any moisture build-up prior to analysis. Otherwise, they will continue to fragment. It is possible to compensate for this kind of attrition during the recovery phase by determining if there are corresponding fragments with modern breaks present in bone bags. If there are modern breaks on the bones, but no corresponding fragments in the bone bag, then the breakage occurred during recovery. For some reason, as yet uncertain, this is less of a problem in the later horizons at the site in spite of the care and attention given to the fauna from the EB by the excavation team.

Faunal recovery at the site is systematic. All excavated sediments from primary contexts (floors, suprafloor, pits, *etc*.) are 100% dry sieved with a 1 cm sq mesh. Those from secondary deposits (fill from collapsed upper stories of houses) are selectively sieved. Tertiary deposits (fill brought in from elsewhere for construction purposes) are not sieved. In addition, selected samples are subjected to a smaller dry sieve mesh of 0.5 cm sq. For the most part, this level of sieving in the field was not found to be profitable since almost nothing identifiable was recovered and it was very difficult and time consuming to do in the bright sunlight while in the field. As a result of the poor recovery of smaller taxa in the dry sieving, beginning in 2010, most of these efforts shifted to an extensive and intensive program of floatation and wet sieving. Each primary and many secondary deposits had at least 10 l of

sediment that was floated and wet-sieved. The data from this part of the recovery program are not reported here since the fauna from this phase are currently undergoing analysis.

Table 9.1. Frequency of fauna by state of weathering (NISP).

Weathering	Sum of NISP	%
Light	2029	93.76
Medium	131	6.05
Heavy	4	0.18
Total	2164	100.00

A sizeable but still small proportion of the assemblage exhibited any evidence for cooking (burning or boiling – 17.2%). Nonetheless, this appears to be larger than that reported for other sites in the larger region (*e.g*. Allentuck 2013; Greenfield 2002; Horwitz and Tchernov 1989; Horwitz *et al*. 2002; Seger *et al*. 1990).

Class/phylum diversity

For the most part, the same pattern at Tell es-Safi/Gath is seen at other non-coastal EB III sites in the region in terms of the taxonomic diversity among medium and large mammals. The vast majority of osteological remains are from mammals (99% NISP). Minor amounts of bird (0.4%), fish (0.23%), reptile (0.14%), shell (0.05%), and crustacean (0.05%) remains were identified among the smaller taxa (Table 9.2). This may be attributable to the lack of wet sieving during this phase of the excavation. There is no evidence of marine fauna, since even the crustacean appears to be fresh water.

Among the mammals, while the vast majority (99% of remains) derive from medium- and large-sized mammals, the largest category is that of medium mammals by far. Small mammals are represented by 1.02%, medium mammals (*e.g*. gazelle, goat, and sheep, including the indeterminate medium mammals) by 77.85% and large mammals (*e.g*. cattle, ass) by 21.12% of the remains (Table 9.3).

State of domestication

One of the questions that arise when dealing with early urban assemblages is the degree of emphasis upon wild resources. It is commonly assumed that cities are associated with the shift to a domesticated economy. This is clearly the case at Tell es-Safi/Gath (Table 9.3). The vast majority of the assemblage that can be distinguished as either domestic or wild (58% of total NISP; n=1,248 NISP) are assignable to domestic taxa (87.6%). In contrast, wild taxa much smaller portion of the remains (12.4%).

Table 9.2. Frequency of fauna by class or phylum (NISP).

Class/phylum	*Sum of NISP*	*%*
Arthropod	1	0.05
Aves	9	0.42
Mammal	2145	99.12
Mollusc	1	0.05
Pisces	5	0.23
Reptile	3	0.14
Total	2164	100.00

Table 9.3. Frequency of phyla and classes by state of domestication (NISP).

Taxon	*Sum of NISP*	*%*
Domestic	1092	87.57
Mammal	1092	87.57
Wild	155	12.43
Arthropod	1	0.08
Aves	9	0.72
Mammal	136	10.91
Mollusc	1	0.08
Pisces	5	0.40
Reptile	3	0.24
Total	1247	100.00

However, even though wild taxa are not as common as domestic, they are still extremely informative about the local ecology and economy (Table 9.3). Most of the wild taxa are mammalian (10.9%). The remainder is dispersed among fish, reptiles, molluscs, birds, and arthropods (2.5%). This tells us that the inhabitants of the neighbourhood exploited a wide variety of local taxa for food, fur,

bone, and other uses.

Taxonomic frequency

In many studies, the frequency of remains are embedded within the larger table that includes various unknown and size category (*e.g.* medium or large mammal). This often minimises the importance of various taxa, the effect of which is visible when one compares the two percentage columns in Table 9.4. Hence, the discussion below uses percentages calculated without such categories in order to take this into account (second percentage column of Table 9.4).

Table 9.4. Frequency of fauna by taxon (NISP).

Taxon	Sum of NISP	%	%*
Domestic	**1092**	**50.46**	**87.57**
Mammal	1092	50.46	87.57
Bos taurus	169	7.81	13.55
Bos/Equus	1	0,05	0,08
Canis familiaris	12	0.55	0.96
Capra hircus	163	7.53	13.07
Equus asinus	7	0.32	0.56
Ovis aries	92	4.25	7.38
Ovis/Capra	639	29.53	51.24
Sus scrofa dom.	7	0.32	0.56
Medium (probably Ovis/Capra)	2	0.09	0.16
Wild	**155**	**7.16**	**12.43**
Arthropod	1	0.05	0.08
Malacostraca	1	0.05	0.08
Aves	9	0.42	0.72
Medium	5	0.23	0.40
Small	4	0.18	0.32
Mammal	136	6.28	10.91
Alcelaphus bucelaphus	4	0.18	0.32
Capreolus capreolus	12	0.55	0.96
Capreolus/gazelle	3	0.14	0.24
Dama dama	19	0.88	1.52
Gazella gazella	76	3.51	6.09
Lepus capensis	2	0.09	0.16
Large	1	0.05	0.08
Medium (possibly Gazella sp.)	2	0.09	0.16
Small	17	0.79	1.36
Mollusc	1	0.05	0.08
Mollusca sp.	1	0.05	0.08
Pisces	5	0.23	0.40
Medium	2	0.09	0.16
Unknown	3	0.14	0.24
Reptile	3	0.14	0.24
Testudo sp.	3	0.14	0.24

Unknown	***917***	***42.38***	
Mammal	*917*	*42.38*	
Ovis/Capra/Gazella	20	0.92	
Large	251	11.60	
Medium	549	25.37	
Small	1	0.05	
Unknown	96	4.44	
Total	***2164***	***100.00***	***100.00***

* % of Sum of NISP excluding unknowns – N=1247

Domestic

The most common taxon in general and domestic taxon in particular are caprines (sheep and goat combined), which represent a combined total of 71.69% of the identified assemblage (Goat-*Capra hircus* – 13.15%, Sheep-*Ovis aries* – 7.3%; sheep/goat-*Ovis/Capra* – 51.24%; Table 9.4). Of these, goats are the most commonly identified since they almost double in frequency of sheep. If we calculate the relative proportion of sheep and goats, goats represent 63.92% and sheep are 36.08% of caprines. If we divide the more indeterminate sheep/goat remains between the two taxa, then the frequencies of sheep and goat become proportionately more comparable to the other taxa. The original goat frequency of 163 NISP is added to an additional 408 NISP=571 (45.83%), and the sheep frequency of 92 NISP is added to an additional 231 NISP=323 (25.87%). After a significant decline in frequency, the next taxon is cattle (*Bos taurus* – 13.54%), dog (*Canis familiaris* – 0.96%), pig (*Sus scrofa* dom. – 0.56%), and donkey or ass (*Equus asinus* – 0.56%).

This pattern is reinforced when we examine the domestic mammals by themselves (Table 9.5). Caprines represent the vast majority of domestic mammalian remains (81.9%: *Capra hircus*=14.93%; *Ovis aries*=8.42%; *Ovis/Capra*=58.52%). There is a dramatic drop down to *Bos taurus* (15.48%) and another dramatic decline to the next group of taxa (*Bos/Equus*=0.09%; *Canis familiaris*=1.10%; *Equus asinus*=0.64%; *Sus scrofa* dom.=0.64%; and indeterminate medium mammal=0.18%).

These frequencies suggest that the vast majority of meat (and by-products) came from caprines, and in particular goats since goats are almost twice as common as sheep. This might be used to argue that goat secondary products (*e.g.* milk), rather than sheep products (*e.g.* wool) would be of greater importance to the inhabitants (Greenfield 1988, 2005; Sasson and Greenfield 2014). As will be demonstrated below, once aging is considered, the situation is even more complex and requires further consideration.

Other than cattle, all of the other taxa are present in quantitatively insignificant frequencies. But, does frequency reflect importance to the inhabitants and the local economy? Clearly not, since taxa that may be rarely culled may also have great social or ritual significance. For example, the low frequency of some taxa, such as cattle, may represent the occasional feasting activities since they are relatively rare but would produce a substantial amount of meat.

Table 9.5. Frequency of domestic mammalian fauna by taxon (NISP).

Taxon	Sum of NISP	%
Bos taurus	169	15.48
Bos/Equus	1	0.09
Canis familiaris	12	1.10
Capra hircus	163	14.93
Equus asinus	7	0.64
Ovis aries	92	8.42
Ovis/Capra	639	58.52
Sus scrofa dom.	7	0.64
Medium	2	0.18
Total	1092	100.00

A second example comes in the frequencies of domestic ass remains, which are also relatively infrequent in the total assemblage (NISP=7; Table 9.4). Their importance needs to be interpreted in light of the extensive trade networks that criss-cross the region and span the distance to other regions, such as Egypt, Syria and beyond. There is a tremendous need during this period to transport goods efficiently across often rough terrain, particularly where it is difficult for wheeled vehicles (Greenfield *et al*. 2012; Milevski 2011).

One of the earliest and complete examples of domestic donkey (*Equus asinus*) skeletons for the region was found beneath the floor of a house associated with Stratum E5 (Fig. 9.4). It was found buried within a shallow pit dug into the E6 horizon which was sealed by the overlying house floor. The skeleton was fully articulated, except for the neck and head, which were found lying on the ribs, but turned toward the rear of the body. It appears as if the head had been cut off in the region of cervical

5–6 before burial. The legs were positioned as if to suggest that they were bound together. The orientation and context of this burial suggests that it was a ritual sacrifice that took place as the houses in this area were being rebuilt between the two strata (E5 and E6). The houses and house walls are built directly on top of each other as if the neighbourhood was being renewed. It can be interpreted as one of the earliest and complete example of this type of domestic ritual (Greenfield *et al*. 2012). In later periods, such burials are found associated with elite and monumental depositional contexts. Domestic asses in this period are used both as beasts of burden in the burgeoning caravan trade, as well as the animal used for elites to ride or draw their vehicles (Katz 2009; Way 2011). As a result, the low frequency of a taxon has little to do with its importance in the ancient world.

The overall distribution of taxa at Tell es-Safi/Gath is reminiscent of that seen from other contemporary EB III sites in the region. In general, caprines are the most common taxon, regardless of the location (Sasson 2008, 2010). The largest difference is in the frequency of goats and the importance of the ass. In most sites, the frequency of sheep is usually higher than that of goats. However, there is large variation in assemblages that can be traced to a variety of sources, particularly size of settlement and environmental surroundings (Davis 1998; Horwitz and Tchernov 1989: table 1; Horwitz *et al*. 2002; Seger *et al*. 1990).

Wild taxa

While wild taxa represent a moderately small proportion of the overall identified assemblage (12.4%; Tables 9.5 and 9.6), the distribution between phyla and classes is very unequal. This is made more apparent when wild remains are examined by themselves (Table 9.6). The vast majority of wild taxa are mammals (87.74% of wild. The remaining wild taxa area divided between birds (Aves – 5.81%), reptiles (*Testudo* sp. – 1.94%), fish (Pisces – 3.23%), arthropods (Malacostraca – 0.65%). This is a fairly typical pattern for dry or unsieved assemblages (Clason and Prummel 1977; O'Connor 2001; Payne 1972; Zohar and Belmaker 2005). Most of the smaller taxa (*i.e*. birds, fish, and arthropods) are not yet fully identified to a specific taxon and will not be discussed here. The rest of this report focuses on the medium and large mammalian remains.

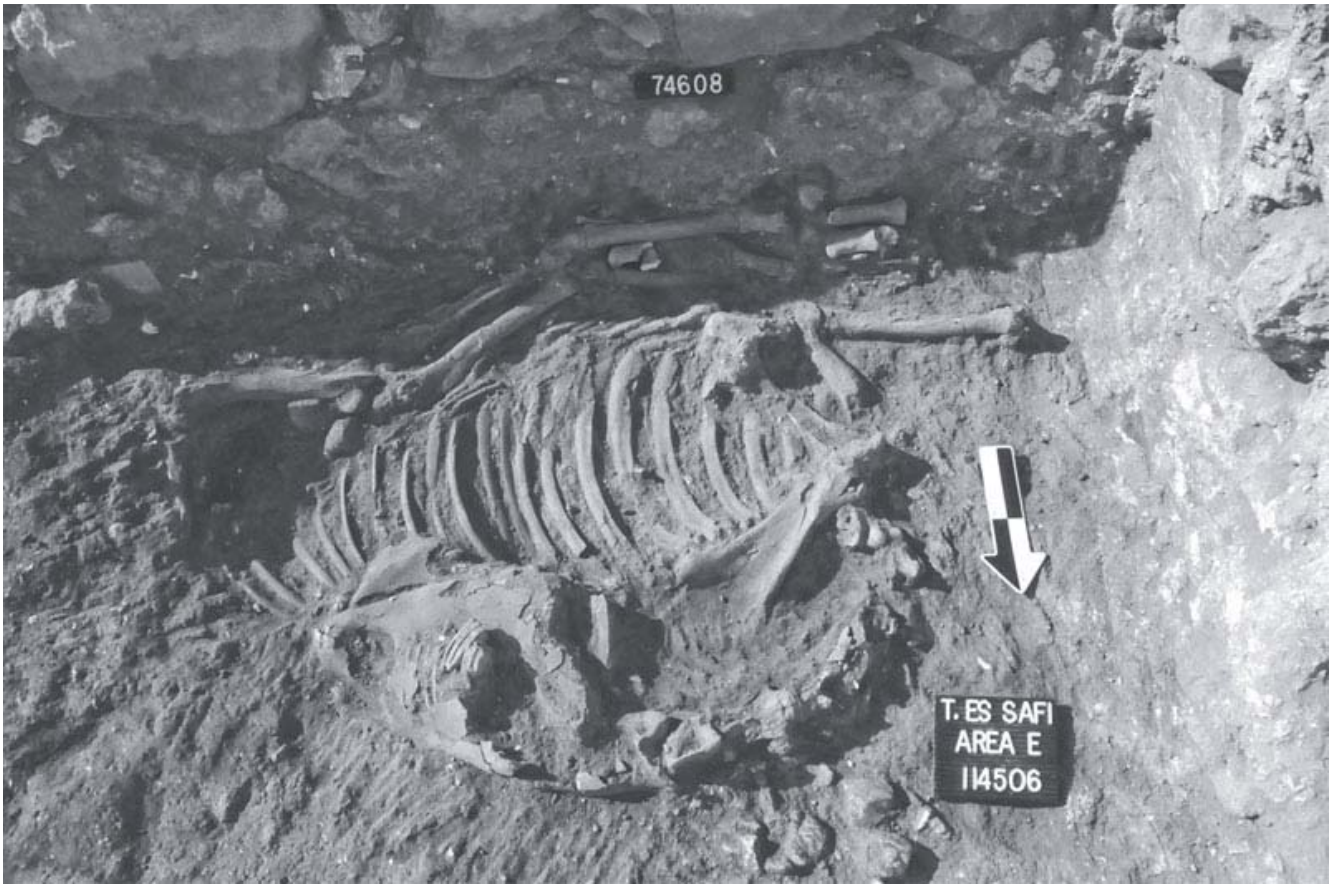

Fig. 9.4. Photo of the donkey skeleton in situ, *facing toward south (L134602).*

Several mammalian wild species have been identified all of which are found in contemporary assemblages in the region (Table 9.6). The most common wild taxon overall and mammalian taxon is gazelle (*Gazella gazella* – 49.03%). They are more than quadruple the numerically closest other taxon, fallow deer (*Dama dama* – 12.26%). Such a high frequency of gazelle among the faunal remains is not commonly seen in other large urban settlements from this time period and region, such as at Tel Halif and Tel Yarmouth (Davis 1988; Seger *et al*. 1990). The remaining mammalian taxa are roe deer (*Capreolus capreolus* – 7.74%), hartebeest (*Alcelaphus bucelaphus* – 2.58% of wild), and hare (*Lepus capensis* – 1.29%).

Table 9.6. Frequency of wild fauna by taxon (NISP).

Taxon	*Sum of NISP*	*%*
Arthropod	***1***	***0.65***
Malacostraca	1	0.65
Aves	***9***	***5.81***
Medium	5	3.23
Small	4	2.58
Mammal	***136***	***87.74***
Alcelaphus bucelaphus	4	2.58
Capreolus capreolus	12	7.74
Capreolus/gazelle	3	1.94
Dama dama	19	12.26
Gazella gazella	76	49.03
Lepus capensis	2	1.29
Large	1	0.65
Medium	2	1.29
Small	17	10.97
Mollusc	***1***	***0.65***
Mollusca spp.	1	0.65
Pisces	***5***	***3.23***
Medium	2	1.29
Unknown	3	1.94
Reptile	***3***	***1.94***
Testudo sp.	3	1.94
Total	**155**	**100.00**

Age-at-death

Given the sample size and the absence of large samples of mandibular tooth rows, it is not possible as yet to generate age-at-death (harvest profiles) from mandibular tooth eruption and wear data. As a result, broad age classes are used to reconstruct the age-at-death patterns. Cranial and post-cranial material was aged based on a combination of epiphyseal and suture fusion, and bone porosity (Greenfield 1986). In the ensuing analysis, the indeterminate subadult/adult age class is removed from the percentage distributions (Table 9.7).

Among the major food livestock exploited at the site, two broad patterns are evident – cattle and goats were culled at very different rates than sheep. Sheep are culled at much younger ages than sheep or cattle. Approximately 50% of cattle and goats were slaughtered as adults, while the frequency of adult sheep is half as much (*ca*. 23%). This type of culling pattern has analogies with exploitations models similar to secondary product exploitation. It suggests that cattle and goats were exploited heavily for their secondary products (*e.g*. milk for both, traction for cattle). In contrast, sheep would have been more heavily exploited for their primary products. Based on the fauna found at the site, these data can be taken to imply that there is little evidence for an emphasis upon a sheep wool production or a large wool industry in this part of the site (Greenfield 1988, 2005; Payne 1973). It is unlikely that this means that domestic livestock production was oriented toward such specialist scenarios or that this reflects herd composition. Most likely, the animals were raised in subsistence oriented herds by locals in the region and brought to urban markets for sale as meat only when it was no longer economic to keep them (*e.g*. before their value began to decline) or their usefulness was at an end (*e.g*. when they no longer could produce high quality milk or wool). Hence, the age at death distribution for the urban assemblage is probably more of a reflection of these economic processes than a direct reflection of urban production modes (Joffe 1996; Sasson 2010; Sasson and Greenfield 2014).

The age distribution of gazelles, the most common wild taxon, is just barely large enough to make some very general observations. What is most interesting is that more age groups (other than infant) are represented (Table 9.7), in contrast to fallow and roe deer where only subadults and adults were hunted. Because these two latter taxa live more solitary lifestyles, they would be hunted as individuals rather than groups. The more diverse age range recovered from Tel es-Safi/Gath for gazelles suggests that they were hunted regardless of age and may even have been hunted through group drives, which would have netted individuals of all ages. Kites for hunting gazelle are found throughout in the desert regions of the Levant (southern and eastern deserts) and in Syria in the Early Bronze Age (Nadel *et al*. 2010; Zeder *et al*. 2013), although none are known from the region surrounding the site.

Table 9.7. Frequency distribution of taxa by age classes (NISP) with the indeterminate subadult/adult age class removed.

	Sum of NISP								%								Total
Taxon	Feotal	Neo-nate	Infant	Infant/ Juv.	Juv.	Juv./ Sub-adult	Sub-adult	Adult	Feotal	Neo-nate	Infant	Infant/ Juv.	Juv.	Juv/ Sub-adult	Sub-adult	Adult	
Domestic																	
Bos taurus			1		8	4	28	42	0.00	0.00	1.20	0.00	9.64	4.82	33.73	50.60	83
Canis familiaris			1			5	1		0.00	0.00	14.29	0.00	0.00	71.43	14.29	0.00	7
Capra hircus					11	5	41	52	0.00	0.00	0.00	0.00	10.09	4.59	37.61	47.71	109
Equus asinus						0	1	5	0.00	0.00	0.00	0.00	0.00	0.00	16.67	83.33	6
Ovis aries	2				16	2	26	14	3.33	0.00	0.00	0.00	26.67	3.33	43.33	23.33	60
Ovis/Capra	1	1	21	4	74	44	108	32	0.35	0.35	7.37	1.40	25.96	15.44	37.89	11.23	285
Sus scrofa dom.					2			2	0.00%	0.00	0.00	0.00	50.00	0.00	0.00	50.00	4
Wild																	
Capreolus capreolus							2	2	0.00%	0.00	0.00	0.00	0.00	0.00	50.00	50.00	4
Dama dama						3	1	1	0.00	0.00	0.00	0.00	0.00	60.00	20.00	20.00	5
Gazella gazella					4	3	14	12	0.00	0.00	0.00	0.00	12.12	9.09	42.42	36.36	33

Conclusions

The archaeological excavations at Tell es-Safi/Gath have uncovered the remains of a substantial EB III city surrounded by fortification (24 ha). This suggests that the site was of major political and economic significance during this period. Extensive excavation of one area of the site (Area E) has in recent years uncovered evidence for a lower stratum neighbourhood. The architectural and artefactual remains from the E5 Stratum dated to the latter half of the EB III suggest that this is the remains of a domestic neighbourhood.

The faunal remains can be used to highlight some aspects of daily life of the inhabitants of this neighbourhood. One observation is that garbage disposal was relatively selective. Most garbage was probably disposed off-site since there are relatively little faunal remains within the architectural complexes. Some remains were thrown out in the alleyway between the architectural complexes on either side, but it is impossible to quantify the volume that was probably discarded in this location since most bone would not have preserved in such a highly trafficked area exposed to the elements, and the torrential rains that would have created a stream course down the alleyway. A hint that relatively little bone may have actually been disposed in the alleyway comes in the form of the high volume of carbonised plant remains that were recovered from this context. It is thought that if the botanical remains were discarded of, but still preserved in high volumes, then the bones should also be preserved. However, this is unlikely given the differing nature of bone – they are larger, would not covered over immediately by sediments, and would be crushed by pedestrians or animals led single file through the narrow alleyway (since the alleyway was not wide enough for wheeled vehicles). As a result, bone would have a lower probability of survival in the alleyway compared to the houses. Until middens are

found elsewhere on- or off-site, it will be difficult to determine how much bone was disposed of beyond domestic residential areas.

Inside the houses, there is little evidence for relatively large quantities or concentrations of bone remains that might represent post-abandonment middens as if the neighbourhood was slowly abandoned. The bones are broadly distributed across rooms as if they represent either the final occupation before destruction and abandonment of the neighbourhood or the remains of a selected portion of bones (*i.e*. for bone tools and ornaments). A combination or either of the above theories makes sense given that it is difficult to comprehend why anyone would regularly dispose of garbage in their living quarters. Archaeologists need to refine their chronologies and deposition contexts in such a way to discriminate between ongoing occupation and abandonment debris. The relatively small quantity of finds from within the houses across this area suggests that most garbage was probably and regularly disposed in the alley or elsewhere.

This preliminary study of the faunal remains suggests an economy heavily oriented toward domestic caprines. Cattle are a distant third. Interestingly, goats are much more common than sheep by a ratio of 1.77:1 (63.9:36.1%). This is particularly relevant when the age-at-death data are considered for each of the taxa. Goats and cattle were culled much later in life than sheep. This age distribution suggests that goats and cattle were initially exploited for their secondary products and only culled when their usefulness for such products had expired. In contrast, the sheep data point to much earlier culling of stock, which suggests that they were culled out of herds for their primary products. Sheep are most often eaten while still immature, in contrast to goats and cattle. The older age-at-death for goats and cattle and the overwhelming emphasis upon goats over sheep suggests that milk was an important by-product and would have been therefore a substantial component of the diet. In contrast, culling animals for their meat (*e.g*. sheep) was a much more minor component of exploitation strategies. Given that it was an urban bone assemblage and that herds were probably raised in the countryside by pastoralists and/or local villagers, the goal of the herders would have been herd maintenance and survival above all (Cribb 1987; Redding 1984; Sasson and Greenfield 2014). Given that it is unlikely that the herds were purely raised for primary or secondary exploitation strategies, the age-at-death patterns among the cattle and goats from Area E probably represent urban selection for particular products after their usefulness for other products had been exhausted.

The occupants of the neighbourhood sacrificed a young and healthy female ass as a foundation deposit while the neighbourhood was being renewed and the houses rebuilt. The selection for an expensive animal, such as this, was probably a reflection of its importance in the local economy or society. It has been suggested that the choice of the ass as a sacrifice might be a reflection that this neighbourhood was the home of a community of merchants and that the ass might have been their totem (*cf*. Milevski 2011).

The faunal data presented here from the first stage of the ongoing excavations of Early Bronze Age deposits at Tell es-Safi/Gath indicate that the site was already a major regional centre by this time period. The analysis of animal remains from the neighbourhood suggest that the inhabitants largely relied upon herded domestic livestock (*i.e*. sheep and goats), emphasised the culling of young sheep for primary products, exploited domestic cattle and goats largely for their secondary products, hunted a variety of wild animals, hunted gazelles possibly in drives, and sacrificed expensive animals best known for transporting goods (domestic donkeys). These provide insight into the nature of animal exploitation

strategies in a non-elite context during the period of early urbanism in the southern Levant.

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Chapter 10

Bronze Age Walls and Iron Age Pits – Contextual Archaeozoology at Oymaağaç Höyük, Turkey

Günther Karl Kunst, Herbert Böhm and Rainer Maria Czichon

This paper presents animal bone assemblages from Bronze and Iron Age horizons at Oymaağaç Höyük, Turkey. The site is identified with the Hittite site of Nerik where a weather god was worshipped. A temple, walls and a tunnel range among the Bronze Age features. In the Iron Age, architectural structures are lacking whereas pits and deposits dominate.

The animal remains derive from separated areas situated near the temple and in the periphery of the settlement. Larger samples and summarized values for periods and feature types were taken as contextual aggregations. Domestic mammals account for 95% of the specimens and proportions within the domestic triad were chosen as analytic tool.

The amount of variability in the proportions of the triad is defined by percentages of the caprines, which go from 50% to predominance in virtually monospecific assemblages. These latter are limited to layers from the temple and may result from communal meals. Other groupings appear linked to feature types. In the Iron Age, deposits and pits differ in their relative species compositions, and the same holds true for Bronze Age deposits and surfaces. Although no consistent diachronic development could be demonstrated, the dispersion of data points was found to be maximal in the Iron Age, less so in Bronze Age open areas and most restricted in architectural spaces. It is suggested that the dispersion within any contextual aggregation represents a strong descriptive tool for the first analysis of complex settlements. It obviously correlates with the uniformity of consumption and disposal habits.

Principal aims and research questions

This paper is meant as a preliminary study on the intra-site variability of faunal samples from a multi-period hilltop settlement. In this first attempt, relative proportions of NISP values within the "domestic triad", cattle, caprines and pig, are taken as a criterion for assessing the variability among the samples. At Oymaagac, these main domestic mammals normally account for over 95% of all identified remains, and appear as an appropriate means for a first quantitative assessment of the faunal samples. Relative proportions based on NIPS values can be quickly visualized via tripolar diagrams (ternary plots;

O'Connor 2003: 136ff.). The authors are aware of the fact that the inclusion of additional taxa and criteria, like skeletal part representation, slaughter patterns or butchery marks, bears the potential to produce complementary and much more refined results. While often used for (super)regional syntheses (*e.g.* King 1999), proportions of the main domesticates, expressed through tripolar diagrams, will be used to identify trends on the intra-site level, in order to better understand local consumption and discard patterns and to reconstruct taphonomic pathways.

Potential causes of quantitative variability

Considering the archaeological setting, the following contrasts and discontinuities might deserve a closer investigation, and may all contribute to the variability in the faunal data.

Diachronic change. Discontinuities are mainly to be expected between Bronze and Iron Age strata, but also within the internal sequences of these periods;

Centre–Periphery. The three investigation areas are separated from each other, occupying different zones relative to the centre of the Höyük and the temple;

Feature type. Animal remains could be collected from practically all feature types documented; differences between types are to be expected for taphonomic reasons related to the function and shape of features.

These aspects should be regarded as being closely interrelated. Behind any differences in species proportions there might be cultural-historical and ecological, or merely functional and "taphonomic" reasons:

> "Changes in the socio-economic status of inhabitants *of the area sampled* (emphasis by the authors) are also frequently associated with important shifts in species distribution. Changes in ethnic affiliation of Gordion residents do not seem to coincide with major shifts in species consumed. Other patterning in the faunal data not discussed here may be more closely tied to ethnically determined dietary practices. It is perhaps more productive, however, to examine influence of these various vectors of change not in isolation but as a tightly interrelated web of social and environmental forces that shape and are shaped by subsistence economy through time." (Zeder and Arter 1994: 105)

In some ways, the approach taken here corresponds to a "stage I analysis" as defined by Zeder and Arter (1994).

Archaeological background

The site of Oymaağaç Höyük is situated close to the southern border of the Turkish Black-sea province of Samsun, about 7–8 km to the northwest of the town of Vezirköprü and on the eastern side of the river Kızılırmak (Halys in Ancient Greek; Fig. 10.1). In geographical terms, the Höyük (hilltop settlement) is located on the northwestern end of the basin of Vezirköprü. The natural hill itself, reaching a height of 286 m a.s.l., stands about 15 m above its immediate surroundings. It falls down in a steep slope on its eastern edge to the outskirts of the recent village of Oymaağaç, less so to the north and south, while the western slopes are only gently descending (Fig. 10.2). The wider area, lying in a transitory zone between the humid and temperate climate of the Black Sea area and the continental conditions of Central Anatolia, is today characterized by agricultural fields with tobacco and wheat as the main crops. Only a few patches of degenerated hornbeam or oak woodland survive at nearby hills,

which are otherwise covered with pastures and shrubs and, at higher elevations, reforestations of pine (Kürschner, internal report). Traces of past human activities, evidenced both by geophysical surveys and archaeological excavations, are widely distributed across the hill, especially around the hilltop and on the eastern and southern slopes. Some incremental growth of anthropogenic settlement layers occurred, especially on the hilltop. Although these may reach a thickness of several meters, the Höyük represents basically a natural feature and does not correspond to a tell or settlement mound in the classical sense.

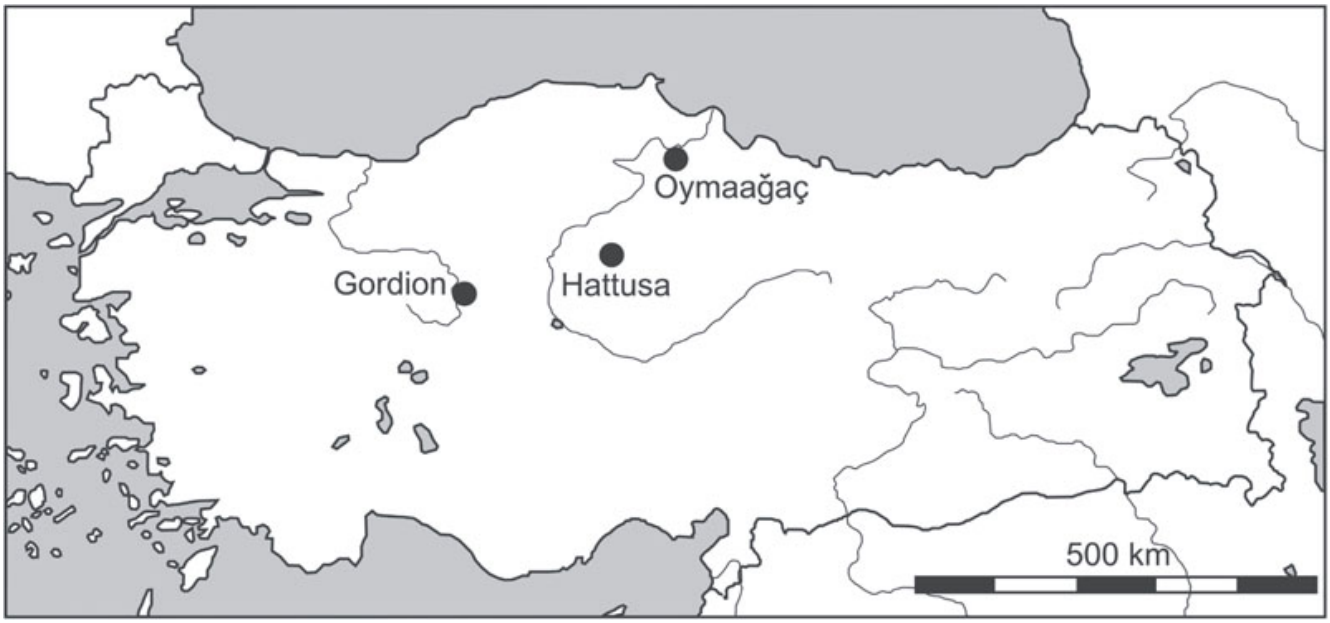

Fig. 10.1. Map of Turkey with archaeological sites mentioned in the text.

The archaeological potential of Oymaağaç Höyük was first recognized by the Turkish archaeologist B. Alkım, who reported on a tunnel (postern) before 1980, and suspected the existence of the remnants of a Hittite settlement on the hilltop. A field survey of the wider area by R. Czichon and J. Klinger (FU Berlin) in 2005 and 2006 yielded promising results. Besides fragments of Bronze and Iron Age and Hellenistic–Roman pottery, several cuneiform tablets of Hittite origin were found (Czichon *et al*. 2006). It is the northernmost place in Anatolia where Hittite remains of comparable quality have been found thus far. In order to get a picture of eventual settlement structures, a geomagnetic survey of the hill surface was carried out in 2006, which was followed by a geoelectric survey in 2009. In the highest area of the Höyük, the foundations of a complex building, covering a surface of about 20x30 m and comprising two yards, became visible. According to comparisons with architecture from other Hittite sites, notably Hattuša-Boğazköy (*e.g*. Schachner 2011), it was provisionally interpreted as temple. Other archaeological structures revealed by the geophysical surveys include a gate complex with a casemate tower to the south-east of the aforementioned building, which obviously represents parts of the eastern city gate. On the eastern and southern slopes of the hill, structures interpreted as sections of a double city wall became visible, and possible remnants of further buildings are scattered over much of the hilltop area.

It has been possible to confirm many results of the surveys by subsequent archaeological excavations. These started in 2007 and were initially aimed at the southern and northern part of the large building (henceforward: temple) and at the adjacent eastern city gate with its preserved northern

tower. The excavation field, meanwhile (2014) comprising most of the upper parts of the Höyük, is divided into a grid of 10 × 10 m squares, orientated north, which form the basic unit for all analyses (Fig. 10.3). The results of the initial campaigns were published in Czichon *et al*. (2011), where the settlement history of Oymaağaç Höyük is outlined: While the Chalcolithic is only represented by stray finds, most of the walled structures belong to the Middle and Late Bronze Age, *i.e*. to the Hittite Empire period. There are a few walls and installations from the Early Bronze Age as well. In the temple, which was obviously finally destroyed by a fire, at least two reconstruction stages can be discerned. The walls were usually constructed in a combined technique, using both stones and mud-bricks, and a wooden framework. Only a few original Bronze Age surface levels survive. One such living floor was found inside one of the chambers of the tower, where a ceramic tub (bathtub or oven?) and various precious items were collected. Most of the artefacts, including the textual remains were found in secondary depositions. Apart from the temple, the gate and the walls, a Middle Bronze Age, square–shaped sunken construction of yet unknown function (granary?), and the tunnel are further major archaeological features from the Hittite era. The tunnel, re-discovered during the first campaign, is partly collapsed and therefore inaccessible in its lower part. It may have contained a sacred fountain and, together with the cuneiform text fragments, constitutes an important argument to identify the site with the religious city of Nerik, mentioned in Hittite literature, and associated with the location of a sanctuary dedicated to the Weather-god of this city.

Fig. 10.2. Oymaağaç Höyük, aerial view from west (source: Oymaağaç-Nerik project database).

Apparently, all text fragments found at Oymaağaç can be dated to the last stage of the Hittite kingdom in the thirteenth century BC (Czichon *et al*. 2010: 220–224). Therefore, the final

abandonment or destruction of the temple and of the settlement in general is assumed to coincide with the collapse of the Hittite kingdom.

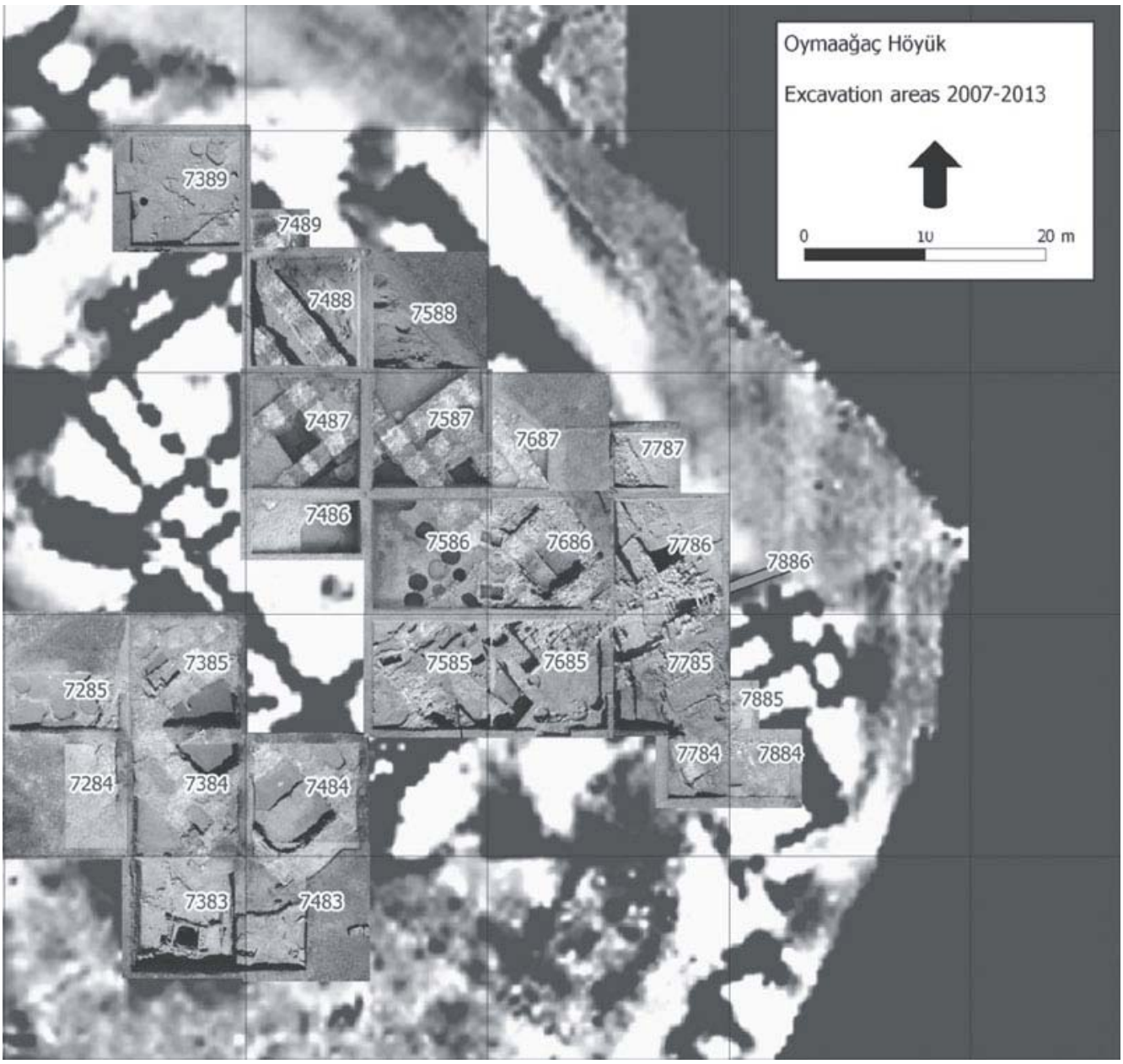

Fig. 10.3. Oymaağaç Höyük, aerial view with excavation areas and geoelectric survey, superimposed (source: Oymaağaç-Nerik project database).

Fig. 10.4. Oymaağaç Höyük, Iron Age pits, September 2013 (photograph: G. K. Kunst).

Despite the great amount of Iron Age pottery found during the survey, this period is hardly represented by architectural features, but almost exclusively by deposits and storage pits, which form a veritable horizon across most of the hill, sometimes cutting deeply into the Bronze Age features (Fig. 10.4). These post-Hittite settlement activities are related to the Kaskians, which are known from historical sources since the Middle Bronze Age, and, later, to the Phrygians. Both ethnic groups are less well documented historically than the Hittites, which puts archaeology as a primary source in the foreground. In the Hellenistic-Roman period, larger areas of the hill were used as burial ground.

Apart from the surveys, the excavations and the study of artefacts, the creation of a digital terrain model and bioarchaeological investigations form integral parts of the project. Other tasks are the elaboration of a chronology of the local Bronze Age based on the pottery, and the conservation of the architecture, including the tunnel, with the aim of presenting the site to the public.

The documentation is based on the idea of open access: Site reports, maps, drawings, photographs and descriptions of archaeological features and objects are available for everybody via the database of the site published under www.nerik.de, where input and change of all relevant data and pictures are possible. This represents a great advantage for material studies, because the context of any find can be immediately obtained.

Methods and explanation of terms

All animal remains treated in this study were hand-collected in the course of the excavations, along with potsherds and other artefacts. The general impression gained from the composition of the faunal

samples is that the bones were collected carefully, which may also be due to the stratigraphic excavation technique applied. Skeletal remains of microvertebrates, and small-sized debris from bone working, constitute regular finds. No research has yet been carried out on the faunal remains from archaeobotanic flotation samples. Archaeobotanic research has been mainly focussed on the fill of Iron Age pits so far (Czichon *et al*. 2010).

Animal remains were identified under field conditions and with a very limited access to comparative material. The remains were, nevertheless, identified to the lowest possible taxonomic category. However, only some of the usual identification problems are of relevance in the case of the domestic triad. Some effort was put in discriminating between axial elements from ruminants and pigs, which tend to be well represented in many samples. Potential identification problems may also arise from the discrimination between wild and domestic forms of the artiodactyls. Osteometric reference data (*e.g*. Driesch and Pöllath 2004) proved helpful. The quantitative data in the tables and tripolar diagrams are based on NISP values or specimen (bone) counts, and these terms are used interchangeably in the text.

About equally important as identification and quantification criteria is the dealing with the archaeological information obtained from the project database, and the use of terms related to the excavation. *Areas*, designated by a four-digit number, are artificial structures defined by the lay-out of the excavation. *Features* refer to archaeological structures documented during excavation whereas *feature type*, a descriptive term, refers to any category defined among these structures. At Oymaağaç, pits, surfaces and deposits are frequent *feature types*. A *locus* (pl. *loci*) is the smallest analytical unit of the excavation, corresponding to the term *stratigraphic unit* in other projects. They are labelled with the number of the excavation *area* and, separated by a colon, an ordinal number defining the *locus*. For the designation of individual finds or samples, a third or even fourth number, separated by a colon, can be added. Due to excavation progress, two or more hitherto separated *loci* can sometimes be pooled into a single *feature* or *context*. This latter term (*context*) is used less specifically within the hierarchical system of the excavation.

Animal remains from Oymaağaç Höyük, specific research questions and topics

At the start of the archaeozoological investigations, a cursory survey of the already excavated material was carried out. Animal remains were found to be constantly present throughout most archaeological features. Therefore, an in-depth study of intra-site variation was envisaged. Up to 2013, 10,902 vertebrate bones and teeth and a few mollusc shells from 201 *loci* of the three areas 7383, 7389 and 7685, with a total weight of 41,548 kg, were analyzed (Table 10.1). Because excavation work is still going on, the results presented here are only preliminary.

Considering the wider area of the Near East, differences in the faunal composition in general, and in the frequencies of domestic mammals in special, have been explained by changes in animal exploitation patterns and economic development (*e.g*. Greenfield-Jongsma and Greenfield 2013, Lev-Tov 2010), by social and ethnic identity (*e.g*. Allentuck and Greenfield 2010; Marom *et al*. 2014; Rossel 2004) and by the topographical situation of sites (Berthon 2013). Especially in multi-period sites, changes are often discussed along an urban–rural continuum (*e.g*. Zeder and Arter 1994).

The interrelationships between archaeological features and their respective animal bone contents therein have been discussed on many occasions, see, *e.g*. Chaix and Méniel (2001: 154) and Kovács *et*

al. (2013). Likewise, the position of the *contextual aggregation* in relation to settlement structures may play a role (Marom and Bar-Oz 2013).

It is generally thought that the preservation of larger species and elements is favored in spacious structures (pits, trenches), whereas small and delicate remains are more easily accumulated within smaller-sized contexts usually related to buildings, eventually resulting in a gradient of increasing average bone size from the centre to the periphery of a settlement (Wilson 1996; Chaix and Méniel 2001). At Oymaağaç, given the chronological and contextual differences among the samples, some factors likely to have an effect on faunal composition were already mentioned above, like diachronic changes in economic background, food preferences, discard behaviour and site function. More specifically, the structural properties of features could be of relevance here, since these different types are unevenly distributed among the historical periods (Bronze Age architecture *vs*. pit horizon of the Iron Age). Cattle are by far the largest species of the triad, and their bones are more likely to be regarded as waste and to be intentionally dumped into suitable structures, than those of the smaller species. Interrelationships between the spatial origin and species proportions of faunal samples in relation to structural properties of a site, like buildings, indoor areas and open spaces and centre and periphery of the settlement, have also been discussed in central and western European settings (*e.g*. Albarella *et al*. 2009; Wilson 1996). Structural (geometric) properties of the features represented at Oymaağaç can be described along the following dichotomies: small – large, laterally extended – restricted, shallow – deep, protected – open, isolated – part of a group or sequence, *etc*.

Table 10.1. General characteristics of the animal bone samples.

Area	*7383*	*7389*	*7685*
Number of loci	101	48	52
Bone weight (g)	18683.8	15200.1	7664.4
Average fragment weight (g)	5.2	3.8	2.3
Total number of specimen (n)	3616	4010	3276
N assigned to size category	1844	2424	1700
N assigned to higher taxonomic unit (NISP)	1772	1586	1576
Bos taurus (n)	340	450	125
Ovis / Capra (n)	1092	895	1301
Sus domestica (n)	272	172	80
N3 (= *Bos, Ovis/Capra, Sus*)	1704	1517	1506
% N3 of NISP	96.2	95.6	95.6

At Oymaağaç, a main point touches the question if a hiatus during the Bronze Age/Iron Age transition, or more specifically at the end of the Hittite kingdom, can be substantiated through the faunal record, independently from taphonomic biases like the different representation of feature types. In regional and chronological terms, the zooarchaeological studies from Gordion (Zeder and Arter 1994) and Hattuša-Boğazköy (von den Driesch and Pöllath 2004) constitute the closest analogues. Here, the transition from the Bronze Age to the Iron Age, connected with a change of site function, is made a subject of discussion. At both sites local (Gordion) or superregional (Hattuša) centres become

small settlements in the Early Iron Age, only to develop again into a regional capital or central settlement in the Phrygian era of the Iron Age.

Comments on the archaeological contexts

Considering the complex archaeological setting and the full access to excavation data, it appears mandatory to relate the archaeozoological results to the contextual informations available. The samples studied are likely to provide a representative cross-section of animal bone assemblages to be expected locally. The three *areas*, spatially separated, work as test areas, allowing for a first assessment of the formation of faunal assemblages at Oymaağaç.

Most of the feature types commonly met on settlement sites, including those mentioned specifically for tells by O'Connor and Evans (2005: 181; *e.g.* levellings and floors), are present, although Oymaağaç Höyük rather represents a hilltop settlement: "The complexity of lateral and vertical variation in tells, from the scale of the tell as a whole to that of individual rooms, mudbrick and plaster layers, allows an amalgamation of different kinds of human activity" (O'Connor and Evans 2005: 181). At Oymaağaç, *pits* and *deposits* are the main types from which remains were collected. While the definition of *pits*, although varying strongly in size and shape, seems obvious, *deposits* can best be described as laterally extended sediment bodies. *Surfaces*, as defined by the excavators, may cover even larger areas. Feature types like *ash* or *rubble layers*, *occupation horizons*, *floors* and *walls* produced much fewer remains. In the following, descriptions of the archaeological lay-out of the three areas and comments on their animal bone contents are given. The chronological position of each *locus* is based upon the pottery associated.

Area 7383

Excavations in this area, situated to the southwest of the hilltop on sloping terrain (Fig. 10.3), started in 2007. The aim was to build up a standard stratigraphy for an area which is only marginally touched by the central building complex (Reichmuth, internal report). The complex setting results in a large number of *loci*: Below the IA (Iron Age) "pit horizon", a LBA (Late Bronze Age) occupation level seals off a MBA (Middle Bronze Age) foundation pit and trench. Below this occupation horizon locus 7383:85, an accumulation of small, flat bowls (*Schalenhorizont*) within pit *locus* 7383:185 was found. An interpretation as offerings is considered. These MBA/LBA structures cut into an EBA (Early Bronze Age) horizon with installations, ash layers, ovens and walls. This is the only case of noteworthy EBA architecture among the areas under discussion. The animal remains (Fig. 10.5) treated in this paper are from the campaigns 2008-2009 and result mostly from the extensive MBA and LBA surfaces and deposits outside the building, and from the EBA ash layers. A noteworthy object, the stonewalled, rectangular MBA structure (granary?) was only excavated more recently and hence its faunal content has yet to be studied. However, the remains from MBA deposits from its immediate vicinity are included here.

Area 7389

This area is situated to the north-west of the hilltop, on gently sloping terrain, on the northern margin of the present excavation area (Fig. 10.3). In its southeastern corner, the geoelectric survey revealed a section of a temple wall. The area was opened in 2010, again with the intention to clarify the

stratigraphy outside of the temple, and to reveal the connection with Hittite architecture already excavated (Reichmuth, internal report). In comparison to area 7383, situated 60 m to the south, larger sections remained undisturbed from post-Hittite interventions. Apart from the wall identified as belonging to the foundation of the temple, the area was nevertheless found to be densely covered with IA pits. Some of these, notably *locus* 7389:037, belong to the EIA (Early Iron Age). Most of the altogether 21 features are deep storage pits with bell-shaped cross sections. Along with the deposits, they yielded the majority of the animal remains collected from this area (Fig. 10.5). Pit locus 7389:033 alone, with a preserved depth of 80 cm, contained 232 bones with a weight of almost 2 kg. An even larger sample of almost 1,000 bones was collected from the IA deposit *locus* 7389:043. The BA architecture and some BA pits were much less productive. About 200 animal remains are from reworked strata of the Hellenistic–Roman surface.

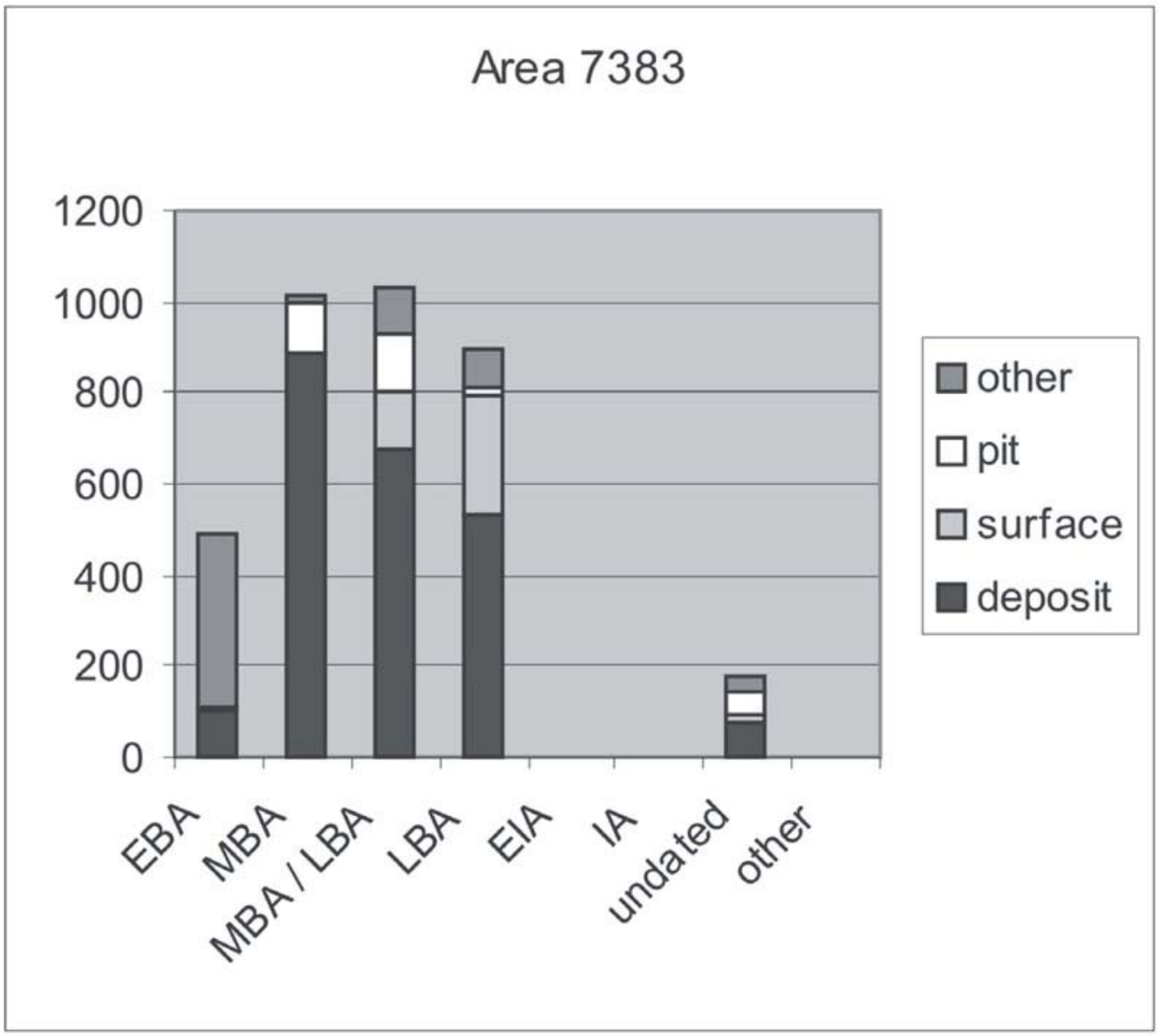

Fig. 10.5 (a). Bone counts according to period and context type for Area 7383.

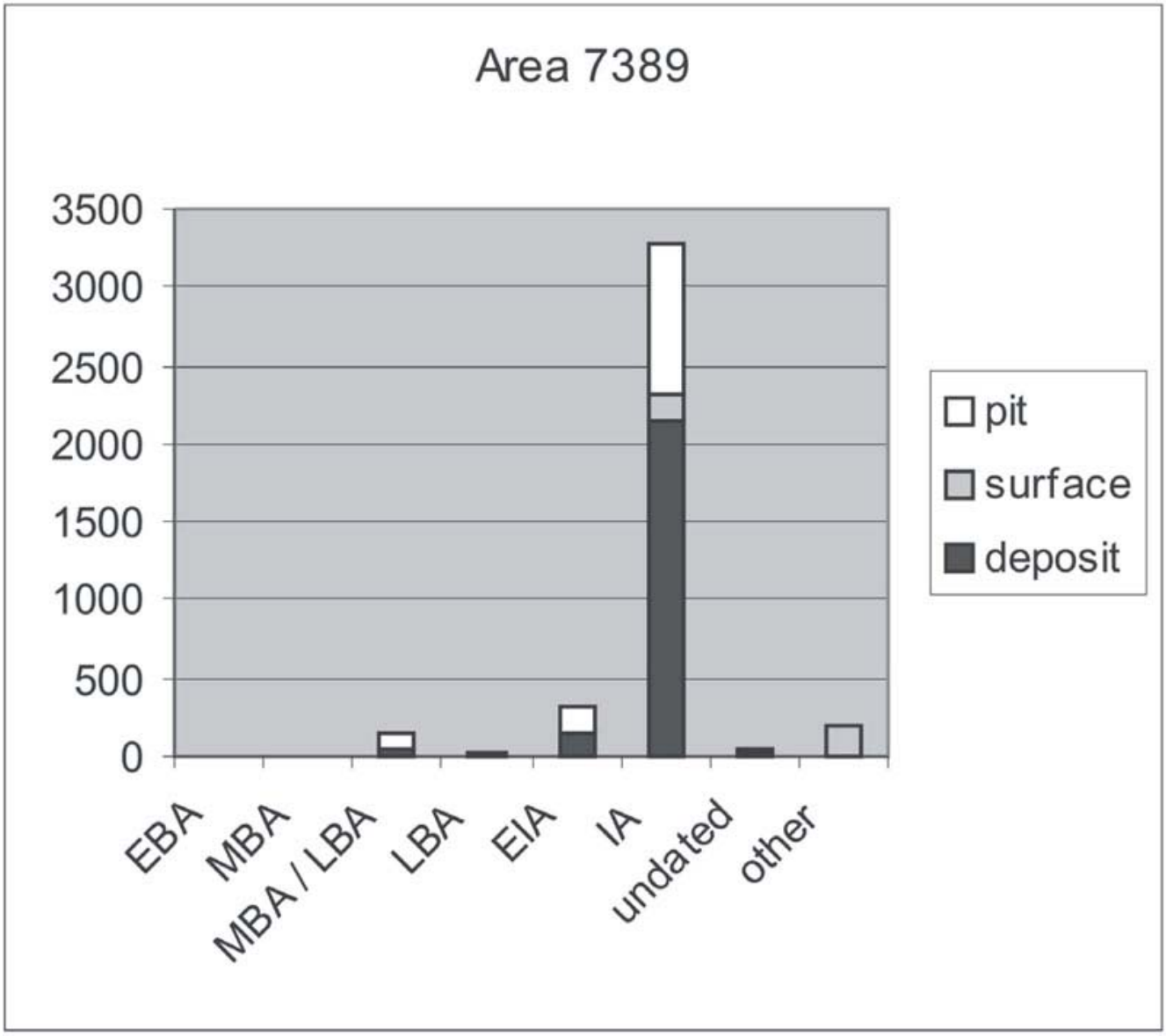

Fig. 10.5 (b). Bone counts according to period and context type for Area 7389.

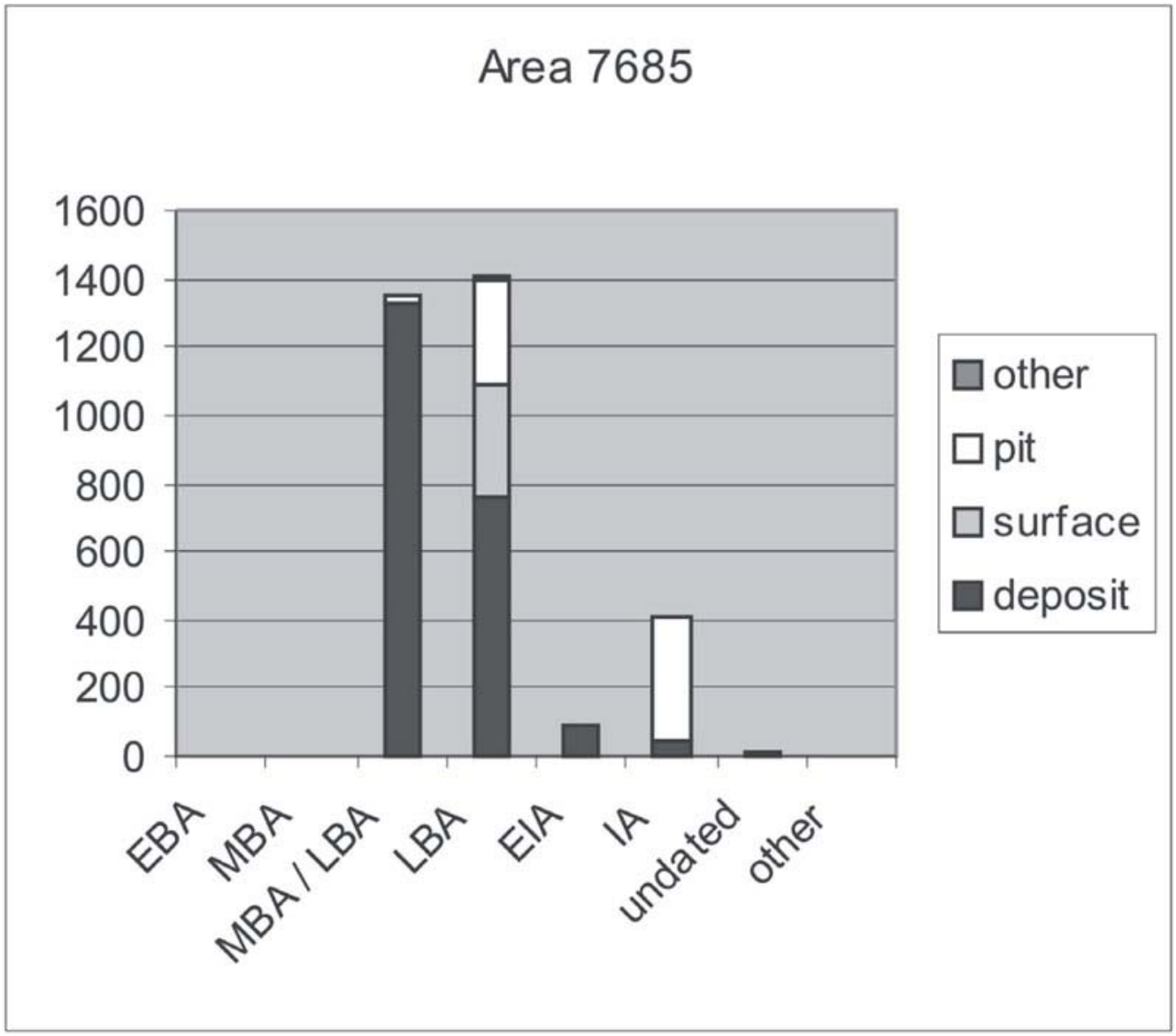

Fig. 10.5 (c). Bone counts according to period and context type for Area 7685.

The animal bone records from the areas 7383 and 7389 appear complementary in their chronological affiliation (dominance of BA *vs*. IA). This is partly due to excavation and research considerations, since the lower strata of area 7389 have not been investigated so far.

Area 7685

Area 7685 is located on the east side of the Höyük, directly west of the tower-gate complex and the entrance of the tunnel, encompassing the south façade of the temple. Excavation works took place in 2010 and 2011. Most assemblages derived from deposits, or similar contexts somehow linked to the architecture of the temple. They accumulated in spaces in-between or around the walls. This taphonomic situation may be responsible for the low average fragment weight of the remains, in comparison to areas 7383 and 7389 (Table 10.1). According to the provisional internal stratigraphy, about half of the material could be attributed to MBA/LBA deposits, the other half to LBA pits, deposits and surfaces. A special type of context is represented by the LBA surface *locus* 7685:142 (Fig. 10.6) and the spatially linked deposit *locus* 7685:137. According to the excavation data (Eerbeek,

internal report), the surface 7685:142 may be one of the few primary or "closed" BA contexts. Due to the important accumulation of intact miniature cups and shallow dishes, and of animal bones, a ritual background was suspected (compare MBA, area 7383). This surface can be interpreted as the archaeological remains of a single (social) event or feast, which took only a short period of time to accumulate. Other MBA/LBA deposits were rather identified as secondary fill. In their archaeological content (complete profiles and vessels, uniform animal bone assemblages dominated by caprines), however, they exhibit many similarities to the surface *locus* 7685:142.

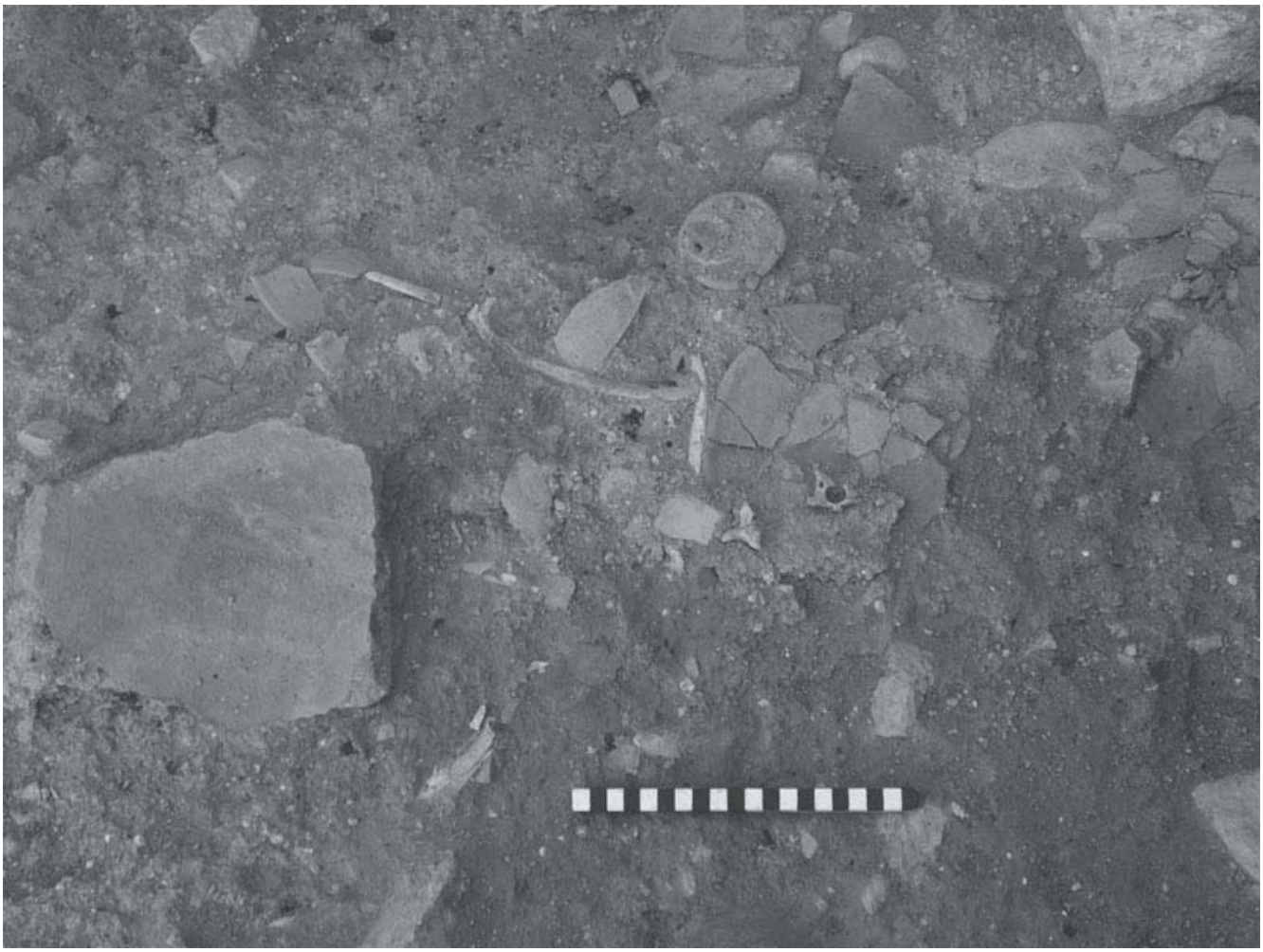

Fig. 10.6. Occupation surface locus 7685:142 with accumulation of pottery fragments and animal bones (source: Oymaağaç-Nerik project database).

Results: intra-site variability in the NISP proportions

Two sets of categories are in the foreground here. One refers to *chronology* and is related to all questions about the diachronic development of production, acquisition and consumption of food, and the discard of food refuse. The transition from a possibly "urbanized" centre of the Hittite kingdom, including a potential religious element at Oymaağaç/Nerik(?), to an allegedly more "rural" and self-sufficient society of the Iron Age, can be expected to have an impact upon the animal bone assemblages generated. Likewise, an internal development both during the BA and IA cannot be ruled out. The second category refers to the *spatial and taphonomic aspect*. It is of particular relevance for the BA, where most of the archaeological features appear to be linked to the organisation of space

around the temple/central building in particular, and the use of the Höyük in general. Due to the massive presence of architecture, the bone remains from the Hittite era derive from a variety of feature types from both inside and outside of buildings. These types are here subsumed mostly under the terms *occupation layers* and *deposits*. Not all BA feature types have been investigated so far (apart from the "granary" also some indoor features, like floors and hearths).

Compared to this, the IA record appears more clear-cut, because assemblages from that period derive, almost exclusively, from pits and deposits. In contrast, large-sized pits are much rarer in the BA. *Taphonomy* is a case in point here, because the representation of feature types and therefore the general conditions for bone preservation are not necessarily consistent in both periods. *Contextuality* is here understood as the interrelationship between shape, function and spatial position of features and their respective bone content.

The percentages for the domestic artiodactyls cattle, sheep, goat and pig of the total of all remains attributed to a higher taxonomic category are similar in all three areas: They are 95.6% for the areas 7389 and 7685, and 96.2% for area 7383. Consequently, most assemblages can sufficiently be described by the relative composition of the main domestic mammals, *i.e*. by the so-called "domestic triad" of cattle, sheep/goat and domestic pig. The use of ternary plots seems therefore justified, because these sufficiently describe most of the variability observed in the samples (O'Connor 2003: 136). The few remains of wild boar could be readily distinguished from domestic pigs by their larger dimensions. Among the ruminants only few if any specimens may possibly derive from the wild forms. The remaining domestic mammals, equids and dogs, only occur sporadically, mainly in IA pits. Like the wild boar, the large wild mammal species red and roe deer, brown bear and lynx are also represented by a few bones only. The brown hare, yet unidentified bird remains and shell fragments of tortoises, are more widespread. Partial skeletons of amphibians, reptiles and rodents were collected from BA and IA pits. No fish remains have been documented so far.

In the ternary plots of Figure 10.7, the proportions of the specimen counts (NISP) for the *domestic triad* of cattle, caprines and pig are indicated and put into relation with both chronology and feature type. Sheep and goat, which could not be separated in most cases, were counted as a single unit of "caprines" (*Ovis*/*Capra*: O/C). Included were samples from 19 *loci* which yielded more than 50 remains of the domestic triad each. The actual specimen counts for the single *loci* included here range from 57 to 371 (mean 118.3). In 17 instances, the remains from all features of the same area and type (*e.g*. pits, deposits) and of identical chronological position were counted together if the combined sum would surpass 50 specimens as well (Table 10.2). Specimens already counted for individual features would be integrated into these data points, which are marked by larger symbols in Figure 7a–c. The specimen counts for these summary units range from 57 to 769 (mean 246.5). The largest samples are the IA deposit locus 7389:043 for individual contexts and the pooled IA deposits from area 7389 for the combined contexts (NISP=371 and 769, respectively). In Fig. 7d, the results for the summary data per area are given for those chronological units which yielded a sufficient amount of remains (NISP=152–1247). These results are also compared to the corresponding data from Hattuša-Boğazköy (Driesch and Pöllath 2004) and Gordion (Zeder and Arter 1994).

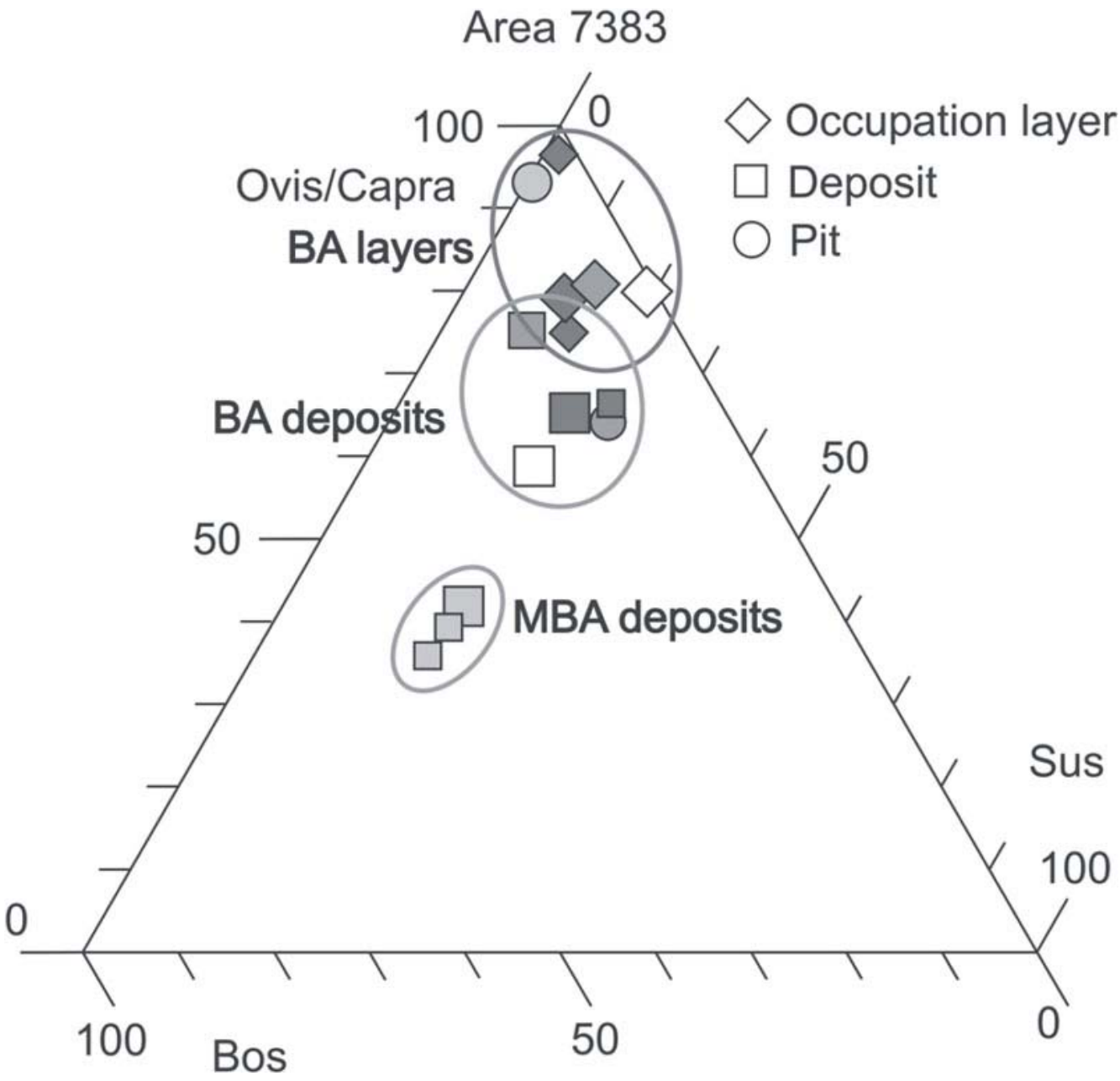

Fig. 10.7 (a). Ternary plots for excavation area 7383, based on the relative quantitative composition (specimen counts) of the major domesticated mammals cattle, sheep/goat and pig.

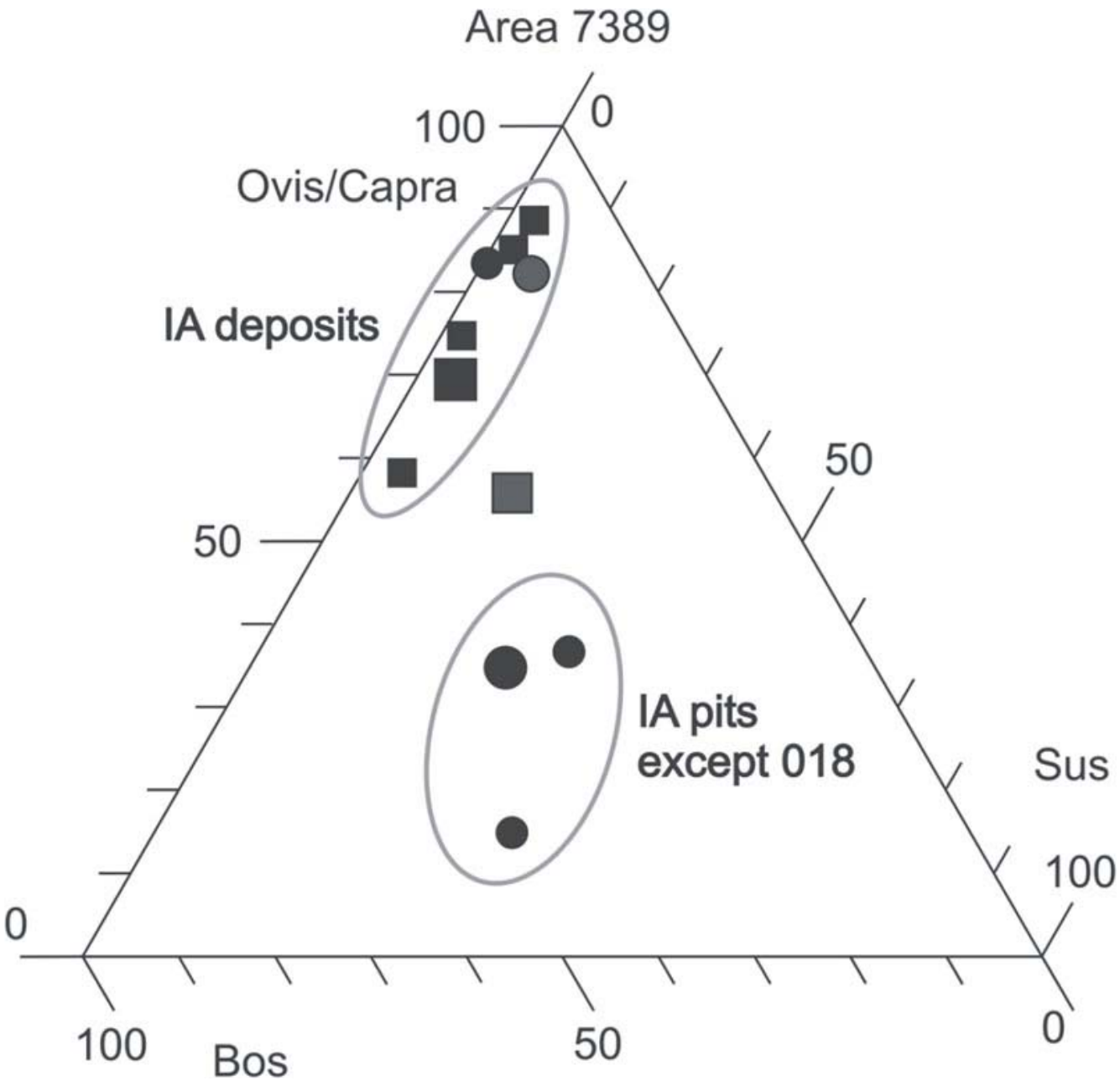

Fig. 10.7 (b). Ternary plots for excavation area 7389, based on the relative quantitative composition (specimen counts) of the major domesticated mammals cattle, sheep/goat and pig.

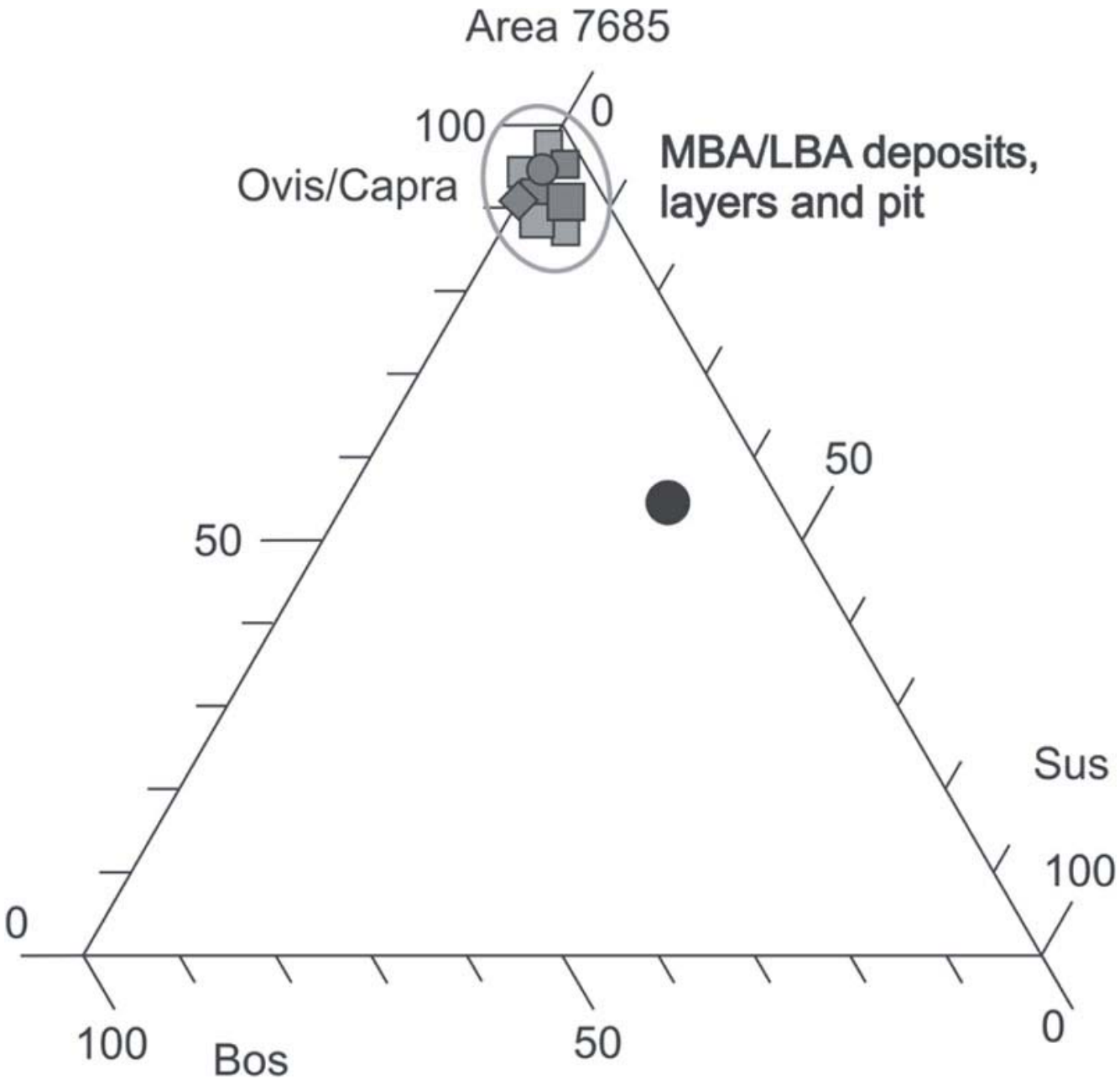

Fig. 10.7 (c). Ternary plots for excavation area 7685, based on the relative quantitative composition (specimen counts) of the major domesticated mammals cattle, sheep/goat and pig.

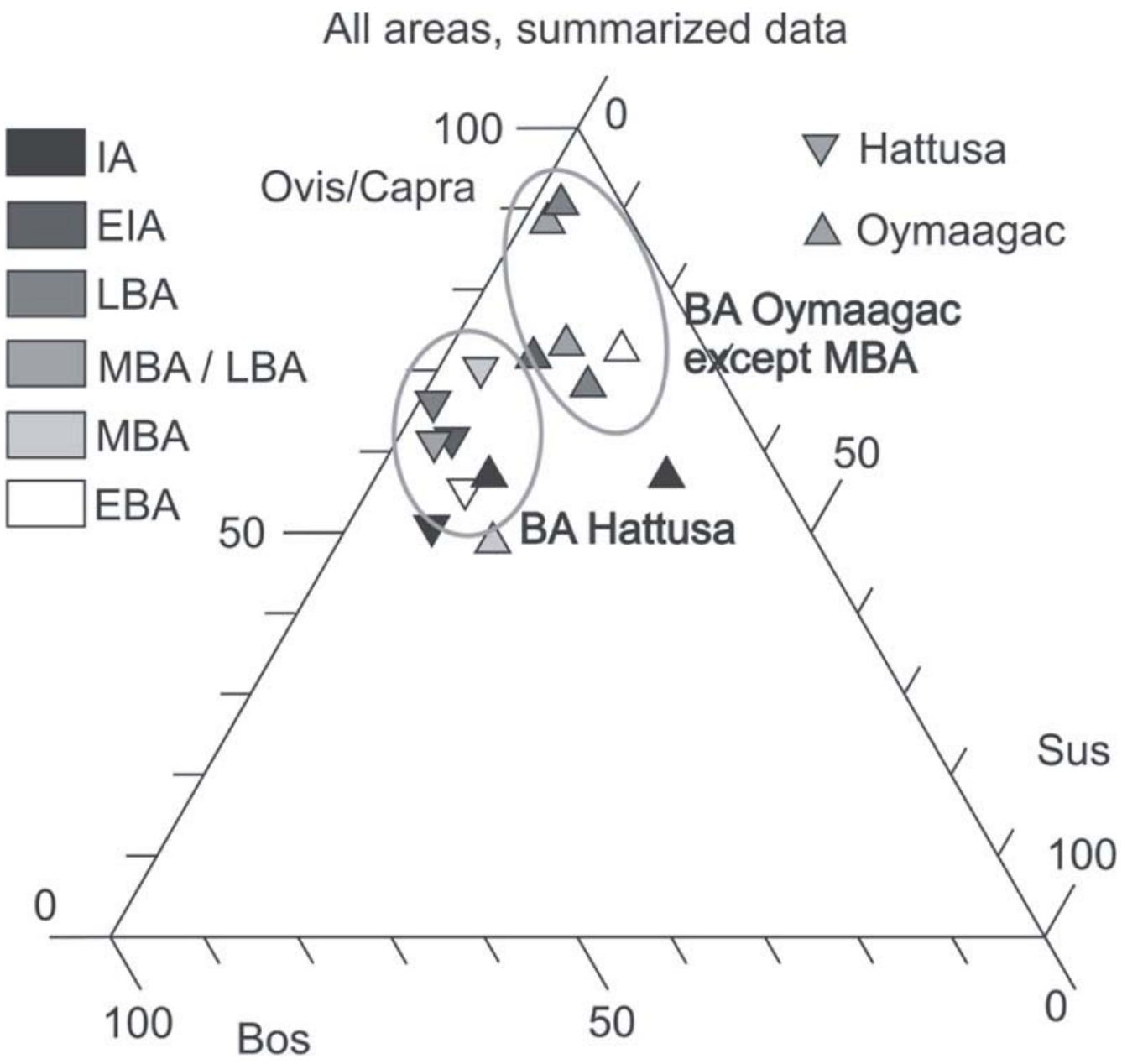

Fig. 10.7 (d). Summarized results for the areas and comparative data from Hattuša-Boğazköy (von den Driesch and Pöllath 2004). Data points for summarized results a) – c) enlarged. Evident clusters of data points indicated by solid lines. For abbreviations see text.

Table 10.2. Amounts of main domesticates in individual analytical units.

Area	*Locus*	*Period*	*Context type*	*Bos*	*O/C*	*Sus*	*N3*	*% Bos*	*% O/C*	*% Sus*
7383	all	EBA	deposit	13	33	10	56	23.2	58.9	17.9
7383	143	EBA	ash layer	1	89	5	95	1.1	93.7	5.3
7383	all	EBA	ash layer	1	120	29	150	0.7	80.0	19.3
7383	256	MBA	deposit	46	36	18	100	46.0	36.0	18.0
7383	259	MBA	deposit	36	34	16	86	41.9	39.5	18.6
7383	all	MBA	deposit	150	155	73	378	39.7	41.0	19.3
7383	all	MBA	pit	4	62	0	66	6.1	93.9	0.0
7383	all	MBA / LBA	deposit	55	267	31	353	15.6	75.6	8.8
7383	all	MBA / LBA	occupation horizon	3	38	6	47	6.4	80.9	12.8
7383	all	MBA / LBA	pit	7	37	13	57	12.3	64.9	22.8
7383	120	LBA	deposit	25	139	45	209	12.0	66.5	21.5
7383	all	LBA	deposit	40	163	48	251	15.9	64.9	19.1
7383	85	LBA	occupation horizon	14	91	16	121	11.6	75.2	13.2
7383	190	LBA	occupation horizon	1	57	1	59	1.7	96.6	1.7
7383	all	LBA	occupation horizon	15	121	17	153	9.8	79.1	11.1
7389	all	EIA	deposit	18	36	10	64	28.1	56.3	15.6
7389	all	EIA	pit	11	73	4	88	12.5	83.0	4.5
7389	7	IA	deposit	24	78	2	104	23.1	75.0	1.9
7389	22	IA	deposit	11	112	3	126	8.7	88.9	2.4
7389	42	IA	deposit	11	73	2	86	12.8	84.9	2.3
7389	43	IA	deposit	141	218	12	371	38.0	58.8	3.2
7389	all	IA	deposit	201	541	27	769	26.1	70.4	3.5
7389	18	IA	pit	9	47		56	16.1	83.9	0.0
7389	33	IA	pit	53	17	41	111	47.7	15.3	36.9
7389	39	IA	pit	26	31	27	84	31.0	36.9	32.1
7389	all	IA	pit	183	166	123	472	38.8	35.2	26.1
7685	103	MBA / LBA	deposit	5	133	0	138	3.6	96.4	0.0
7685	108	MBA / LBA	deposit	4	53	0	57	7.0	93.0	0.0
7685	113	MBA / LBA	deposit	6	86	6	98	6.1	87.8	6.1
7685	all	MBA / LBA	deposit	63	616	14	693	9.1	88.9	2.0
7685	all	IA	all contexts	19	87	47	153	12.4	56.9	30.7

7685	133	LBA	deposit	4	82	1	87	4.6	94.3	1.1
7685	137	LBA	deposit	7	90	1	98	7.1	91.8	1.0
7685	all	LBA	deposit	23	326	13	362	6.4	90.1	3.6
7685	60	LBA	pit	5	98	0	103	4.9	95.1	0.0
7685	142	LBA	surface	12	139	3	154	7.8	90.3	1.9
7685	all	IA	pit	15	68	42	125	12.0	54.4	33.6
7383	all	EBA	all contexts	19	161	41	221	8.6	72.9	18.6
7383	all	LBA	all contexts	66	305	76	447	14.8	68.2	17.0
7383	all	MBA	all contexts	157	219	73	449	35.0	48.8	16.3
7383	all	MBA / LBA	all contexts	71	361	59	491	14.5	73.5	12.0
7389	all	EIA	all contexts	29	109	14	152	19.1	71.7	9.2
7389	all	IA	all contexts	387	708	152	1247	31.0	56.8	12.2
7685	all	MBA / LBA	all contexts	63	616	14	693	9.1	88.9	2.0
7685	all	LBA	all contexts	40	570	16	626	6.4	91.1	2.6
7685	all	IA	all contexts	19	87	47	153	12.4	56.9	30.7

Area 7383 **(Fig. 10.7 (a))**

Results for five individual *loci* and nine summarized units are indicated. With the exception of the MBA, most of the data points concentrate in the upper part, with over 60% of caprines. The two summary samples for the EBA are from ash layers and deposits. The ash (occupation) layers, a representative sample of 150 specimens, are practically devoid of cattle bones, and pigs reach almost 20%. In the coeval EBA deposits, the caprines stay slightly below 60%, while cattle and pigs appear in about equal amounts. In the MBA, there is also a remarkable disequilibrium between the feature types: pits, with no pigs and almost 95% O/C, differ from deposits. Notably pit 7383:185, the dominant feature, is linked to an accumulation of small vessels and contains no other mammals except caprines. The MBA deposits 7383:256 and 259 (pooled NISP=186), on the other hand, are *loci* without a total dominance of caprines, and a remarkable percentage of cattle and pigs, which is outstanding among the BA samples. Both deposits are spatially related. The combined sample for the MBA deposits is based on twice as many bones (NISP=378) and summarizes remains from altogether eight *loci*. It is situated quite close to the data points of the two individual deposits, indicating a common trend in the MBA. It is the only summarized BA data point with a caprine value of less than 50% and a dominance of cattle. Among the mixed MBA/LBA samples, only the summary value for the deposits can be based on a large sample (NISP=353). It exhibits a clear dominance of caprines, but also a sensible amount of cattle. The remaining MBA/LBA feature types are numerically weak and deviate slightly from the deposits, into different directions. Also in the LBA, caprine percentages tend to be higher in the occupation surfaces than in the deposits. Two spatially related *loci*, the deposit 7383:120 and the occupation horizon 7383:85, are both extended features which seal the pottery accumulations below them and yielded

large samples (NISP=209 and 121), differing slightly in their caprine/pig ratio. The small sample (NISP=59) from the restricted LBA occupation horizon 7383:190 should not be ignored either: according to the database, a total dominance of caprines coincides with an accumulation of small vessel fragments (compare area 7685) in the MBA layers, amongst them the already mentioned MBA pit 7383:185 underneath. Thus, caprine percentages are higher in LBA layers than in coeval deposits, while cattle/pig ratios are mostly balanced here.

Deposits are the most productive feature type (total NISP=1038), followed by ash layers and occupation horizons (surfaces; 350) and pits (123; see also Fig. 10.4). Caprine percentages are consistently lower in deposits than in surfaces. Except for the special position of the MBA deposits, no diachronic trend could be detected. No utilizable IA samples are presently available from this area.

Area 7389 **(Fig. 10.7 (b))**

Due to insufficient sample sizes in the BA, only EIA and IA data from seven individual *loci* and four feature summaries were used. The data points scatter across a large surface, mostly in the left half of the triangle. This means that cattle are usually better represented than pigs. The summary values for EIA pits (NISP=88) and deposits (NISP=64) are clearly separated: while the result for the pits is close to the ovicaprine maximum, cattle and pigs appear more frequently in the deposits. The majority of the remains derive from IA deposits, followed by IA pits. Individual data points are given for the loci 7389:007, 022, 042 and 043. It seems remarkable that these are distributed along the cattle–caprine connecting axis, roughly between caprine values of 60–90%, implying very low percentages of pigs. The corresponding values for cattle go from 9% to 38%. The summary data for all deposits (NISP=769) combines 70% of caprines with 26% of cattle. Quite divergent results could be obtained from the IA pits 7389:033 and 039 (NISP=111 and 84): while cattle and pigs dominate over caprines in the former, the latter exhibits an almost equal distribution for all three groups (31–37%). The small sample from the IA pit 7389:018, however, is devoid of pigs and characterized by caprine dominance. The summary value for all IA pits (NISP=472), which includes 11 more contexts, lies close to the centre of the triangle and to the data point of pit 7389:039. The more balanced representation of the major domesticates within IA pits might therefore represent a true trend. Pit 7389:033, apart from the scarcity of caprines, is also outstanding in another respect: it produced seven equid remains, the largest amount found within one single *locus* so far.

In the IA assemblages from area 7389, the major dividing line is situated between assemblages from deposits and pits. The former exhibit high percentages of caprines and varying amounts of cattle, while pigs are scarce throughout. The latter, mostly, yielded assemblages with low caprine percentages or with a balanced distribution of all three components. EIA pits and deposits suggest an opposite trend, but the NISP values are low here.

Area 7685 **(Fig. 10.7 (c))**

In this area, data for seven individual *loci* and three summarized context groups are available. The distribution of the data points appears rather unique. For the IA, only the samples from the pits provide a large set of data. It is based on 125 bones from seven pits, and the resulting point is situated near the right side of the triangle, indicating a fair representation of caprines and pig, with cattle taking the third place. The remaining nine data points consist of three MBA/LBA and two LBA individual deposits,

one LBA surface and pit, and summary data for MBA/LBA and LBA deposits. Whether individual or summarized, they are huddled together close to the sheep/goat maximum, with two points even above the 95% limit. As for the mixed MBA/LBA assemblages, the results for the deposits of loci 7685:103, 108 and 113 are based on representative samples (NISP=57–138), and the summarized group of deposits even on 693 remains from, altogether, 21 *loci*. The deposits 103 and 108 are totally devoid of pig remains. As mentioned in the excavation report by J. Eerbeek, these two deposits are classified as secondary fill, although they were made up of a large number of intact vessels and fragments of animal bone. The LBA surface locus 7685:142 (NISP=154), is likewise dominated by caprines (90.3%), but also contained some remains from cattle (7.8%) and pig (1.9%). It was interpreted as a primary, closed context because of the high density of complete vessels (Fig. 10.8) and animal bones, which were found in close spatial association. The LBA deposits 7685:137, closely linked to surface 142, and 7685:133 both exhibit similar relations of the major domesticates, with caprine percentages of well over 90%, cattle ranging between 4.5% and 7% and minimal percentages of pig. All LBA deposits taken together (NISP=362) exhibit slightly higher pig percentages (3.6%) than the mixed MBA/LBA assemblages, but the relations, based on 362 remains from 16 *loci*, are otherwise similar. The LBA *locus* 7685:060 (NISP=103), classified as pit, yielded another assemblage totally dominated by caprines and devoid of pig remains. The animal bone assemblages from the BA deposits and surfaces of area 7685 appear as products of similar, if not identical, accumulation processes. The data points of the BA contexts in Figure 10.7c are based on altogether 1,312 remains.

Fig. 10.8. Complete miniature cup from occupation surface locus 7685:142 (photograph by H. Marquardt, Oymaağaç-Nerik project database).

Apart from the obvious differences between IA pits and the total of the BA samples, the

conditions within these latter are characterized by a uniform dominance of caprines, persistent throughout all feature types. Cattle and pig achieve maximum values of 9.1 (all MBA/LBA deposits) and 6.1% (MBA/LBA deposit 7685:113), respectively.

Summarized results and comparison with Hattuša-Boğazköy and Gordion

In Figure 10.7d the summarized data from each area are presented according to period. For comparison, the results from Hattuša-Boğazköy (von den Driesch and Pöllath 2004) are given. The results are now based on larger samples, specimen counts range from 152 (EIA in area 7389) to 1247 (IA in area 7389). Generally, the data points occupy the upper part of the triangle: caprines always account for over 50% of the NISP, with the exception of the MBA from area 7383 which just misses this limit. Area 7383 is represented by samples from all periods of the Bronze Age (EBA, MBA, MBA/LBA and LBA). Except for the MBA, the data points occupy a comparatively narrow field around 70% of caprines, either at the centre or slightly shifted to the right side, implying that pigs are sometimes more frequent than cattle. The isolated position of the MBA sub-sample of area 7383, which was already noticed above, is due to a balanced proportion of ruminants and a fair percentage of pigs.

In area 7389, the summarized results for the EIA exhibit quite high proportions of caprine remains. For the IA, characterized by strong disparities between pits and deposits in area 7389, the resulting data point occupies an intermediate position. The value for caprines is about the same as in the IA sample from area 7685, which appears shifted to the right, implying a higher pig percentage: in contrast to area 7685, with a pig percentage of over 30%, cattle are taking the second place in area 7389. Both summarized IA data points correspond in their low proportions of caprines, which clearly set them apart from the bulk of the BA samples.

On the opposite side of the scatter, caprine dominance is total for the summarized results for the MBA/LBA and the LBA of area 7685: These two data points occupy an area close to the caprine maximum, isolated from the remaining scatter.

The summarized results for Hattuša mostly do not overlap with those from Oymaağaç. Although the percentages of caprines correspond with the lower range of Oymaağaç (50–70%), the whole field appears to be transposed downwards and to the left, *i.e*. towards the "cattle side". At Hattuša, cattle (25–40%) are generally better represented than pigs (below 10 %). The lowest values for caprines, which never fall below 50%, are present in the EBA and in the IA. The remaining sections of the BA and the EIA exhibit percentages for caprines between 60% and 70%. The only corresponding data points from Oymaağaç are from the IA of area 7389, while the EIA from the same area and the MBA from area 7383 only marginally touch the dispersion of Hattuša. This latter data point, based on 449 specimens, exhibits lower caprine and higher pig percentages than any of the summarized values from Hattuša.

The results from Gordion (Zeder and Arter 1994) were not integrated into the diagram of Figure 10.7d. The scatter of the BA and IA data points for Gordion, by and large, coincides with the variation range of the summarized BA and EIA distributions from Oymaağaç. At Gordion, caprines constantly account for 60% or more of the total. Their percentages exhibit an increase from the Old Hittite period (62%) to the EIA (88%), to be followed by a marked decrease in the later stages of the IA (Middle Phrygian: 60%; Zeder & Arter 1994: 109–111). The data points for the last Hittite period and the EIA

are situated about as close to the caprine maximum as those from the mixed MBA/LBA and LBA horizons at Oymaağaç. At Gordion, contrary to the other sites, no tendency of a general decrease in caprine percentages in the IA in comparison to the BA is observed. With the exception of the Early Hittite and Middle Phrygian eras, cattle are more frequent than pigs, or both groups are equally represented. Cattle percentages vary between 7% (EIA) and 19% (both Older Hittite empire and Middle Phrygian IA), but never reach percentages as high as those met in Hattuša-Boğazköy or in the IA features at Oymaağaç. Therefore, there is definitely no overlap between the data points from Gordion and Hattuša, where cattle percentages range between 25% and 40%. At Gordion, pig percentages vary between 5% (EIA) and 22% (Old Hittite period).

Discussion and conclusion

General remarks on taxonomic variability

The animal remains treated in this study derive from three segregated excavation trenches, situated 25–50 m apart. These *areas*, occupying different parts within the settlement, represent arbitrarily arranged units within the continuum of the site and yielding about the same amount of remains each (Table 10.1; Fig. 10.2). The samples collected are therefore likely to contain only a section of the horizontal and vertical (diachronic) variability present. The NISP proportions within the domestic triad, a "coarse" method of quantification, visualized by the scatter of data points in the ternary plots of Figure 10.7, reveal a considerable variability. It obviously mirrors the complex archaeological situation and is present both within and between the observation categories (areas, periods and feature types). It is, however, mostly the upper part of the triangle which is occupied, implying a widespread predominance of caprines of over 50%. It should be kept in mind that in Figure 10.7, three different categories of contextual aggregations (*sensu* Marom and Bar-Oz 2013) were chosen as analytical units: individual *loci* with NISP counts (domestic triad) >50; summaries for the same feature type per period and area (these two in Fig. 10.7 (a)–(c)); summaries per period and area (Fig. 10.7 (d)). Clearly, the choice of categories of contextual aggregations has an effect on the resulting data scatter, even though the elements of the same category often follow a similar trend.

Both feature types and periods are represented differently within the three areas (Fig. 10.2). Some of the differences in species representation are therefore probably due to these discrepancies. Apart from the relative proportions of the main domesticates in each of the samples presented, *concentration* and *dispersion* of the data points representing them are another aspect made apparent by Figure 10.7. Dispersion may by itself constitute a characteristic feature within an analytical category. Obvious examples from Oymaağaç are the wide dispersion of data points in area 7389, as opposed to the concentration in area 7685, with area 7383 taking an intermediate position. From Figures 10.5 and 10.7 it becomes clear that dispersion is not directly linked to the diversity of periods and feature types represented. This diversity is definitely lower in 7389 than in the two other areas, which both include a wider, or at least equivalent, array of different feature types, individual *loci* and periods. Area 7383 is the most varied as far as feature types and stratigraphic periods are concerned, while area 7389 exhibits the most extended dispersion across the triangle. In stratigraphic respect, the records within the three areas are complementary to each other: area 7389 is dominated by IA, the other two by BA assemblages.

Naturally, both intra- and inter-site comparisons only make sense if the available chronological

and contextual data are made use of. Intra-site analysis may here refer to observations made within each area, and within the three areas taken together.

Bronze Age–Iron Age transition

From a historical and archaeological viewpoint, the BA–IA transition, associated with the fall of the Hittite kingdom, represents a central issue among the *diachronic developments*. Because of the uneven distribution of dated contexts across the three areas, it can only be discussed on the level of the whole material. The situation for Oymaağaç is best described by the deviation of the IA samples, including the EIA, from those of the BA which form the majority of the finds (NISP of the triad 1552 *vs*. 2927, respectively). The cumulative EIA data point for area 7389 lies marginally, those for the IA of the areas 7389 and 7685 clearly outside the respective main scatters for the BA. This is due to the comparatively low caprine percentages of about 57% in these two cumulative IA samples (Fig. 10.7 (d)). It is only among the MBA samples from area 7383 that we find even lower percentages of caprines within cumulative analytical units. Conditions are more complicated if we look at the results for individual samples and the means for the two feature types. With the notable exception of pit 7389:18 which is grouped along with the deposits, but including the summary results for IA pits from area 7685, a clear dichotomy according to feature type can be discerned for the IA (Fig. 10.7 (b), (c)): percentages of pigs and, partly, cattle appear to be generally higher, and those for caprines to be lower in pits than in deposits. This is the most consistent trend concerning the impact of feature types on species representations among the whole material. It includes a considerable disjunction between the two feature type-defined sub-groups. Conceivably, preservation conditions inside the spacious pits would favour the larger cattle bones at the expense of caprine frequencies, but the differences in the representation of pigs are less easily explained in taphonomic terms. According to Marom and Bar-Oz (2013: 233): "deposits in streets and open spaces inside the settlement would reflect with greater accuracy the time-averaged daily consumption activities of nearby functioning architectural spaces". In other words, different feature types (or aggregation units) are likely to produce different qualities of data (Marom and Bar-Oz 2013: tables 2–3). Pit fills, on the other hand, may have accumulated during a shorter time span and are more likely to mirror single events. It is nevertheless noteworthy that both IA feature type groups deviate from the main BA scatter, albeit in different directions.

All in all, it is difficult to recognize a clear-cut dividing line between the two periods, let alone between the BA and the poorly represented EIA, because the dispersion of data points *within* the IA appears to be even greater than the respective differences between the BA and the two feature type groups of the IA. In fact, this very dispersion of the IA data points, as opposed to the narrower scatter of the BA samples, may represent the main difference between assemblages from the two periods. Apart from the physical properties of IA features, it may be indicative of a less constrained or standardized consumption and disposal regime during this period. Without doubt, the spacious shapes of IA *pits* favoured the preservation of larger remains from both cattle and pig. The low percentage of pigs in IA *deposits*, persisting throughout several loci and based on a large material, represents the most idiosyncratic trait of these features. It is highly at odds with the raised pig percentages within the, supposedly coeval, pit fills.

Internal development of the BA

The rich inventory of BA samples from the areas 7383 and 7685 allows for a comparative analysis of the impact of chronological position, feature type and the presence of building structures on faunal composition. Since area 7685 encompasses the entrance part of the temple, more loci are immediately connected to architecture than in area 7383, where only one corner of this building complex is situated. Clearly, the two areas exhibit differences in the dispersion of the data points: these are widely dispersed in area 7383 and huddled in area 7685 (Fig. 10.7a, c). The specimen counts of the triad in both areas are comparable: 1511 in area 7383 *vs*. 1312 in area 7685.

In area 7383, where all stages of the BA are represented, groupings concerning period and feature type are apparent. The divergent position of the MBA deposits has already been commented upon. It may be linked to a special consumption or disposal regime around the rectangular structure, possibly corresponding to those of the IA pits, where similar species proportions are present. Originally, these layers were interpreted as the platform required for the operation of a "well".

The highly consistent results from about five of these neighboring MBA deposits give reason to discuss another topic: Feedback and control for the classification and interpretation of archaeological features by the study of faunal remains. In the present case, the various *loci* defined as MBA deposits may in fact represent one single aggregate, which was split up in the course of the excavation.

From Figure 10.7 (a) it becomes also clear that in the other periods of the BA from area 7383, occupation layers (and related feature types) tend to exhibit higher percentages of caprines, and often also of pigs, and consequently lower percentages of cattle, than coeval deposits. In comparison to the differences between IA pits and deposits in area 7389, these trends are less distinct. They are nevertheless based on over 1000 remains from different stages of the BA, where they appear consistently and independently. This condition, too, may be related to size sorting, and to the relationship to primary activity areas (occupation horizons), where the deposition and preservation of smaller remains was favored. Apart from these merely "taphonomic" or non-cultural reasons, the idea of different data qualities can be put forward again: Like in the different IA contexts, deposits may reflect the time-averaged fall-out, while the assemblages from the features summarized under the term "occupation layers" could be more closely related to single disposal events.

In area 7685, the BA data points are crowded together near the caprine maximum regardless of the feature types defined, indicating a reduced variability. The reasons for this, among others, can be seen in the restricted range of feature types and periods: the majority of the remains derive from mixed MBA/LBA and LBA deposits, and the other feature types, one pit fill and surface each, remain inside this spread. All these assemblages, mostly situated outside the range of chronologically and taphonomically corresponding counterparts from area 7383, possibly belong to a close-knit group of related contexts. These layers or surfaces from area 7685, sometimes designated as deposits or pits, frequently contained pottery accumulations with (partly) complete vessels, namely miniature cups. They probably share a common mode of depositional history. Three *loci*, 7685:103, 108 and 60, yielded dispecific (concerning the domestic triad: containing two taxa only) assemblages without pigs. The cumulative NISP for them is about 300. Deposit 7685:103 ("fill between walls") even comes close to a monospecific assemblage with 96.4% of caprines, a highly significant result with respect to a NISP of 138! In area 7383, the LBA occupation horizon 7383:190 also produced a nearly monospecific assemblage of caprines. The same holds true for the summarised MBA pits (dominated by pit 7383:185) where pigs are missing totally. In both context groups, also accumulations of complete

vessels (small bowls *etc*.) have been found. A *taphofacies* of assemblages from the surroundings of buildings, dominated by the remains of caprines and associated to accumulations of small vessels, can therefore be defined for both areas. Another group of de-facto dispecific assemblages, rich in caprines, with a moderate amount of pigs, is represented by the EBA ash layers from area 7383, collected around an oven and a mudbrick wall. Of these, ash layer 7383:143 also comes close to a monospecifc assemblage with 94% of caprines.

Although appearing in marginal positions in the diagrams of Fig. 7, assemblages strongly dominated by caprines do by no means represent statistical outliers at Oymaağaç. They make up for over 30% of the total NISP of the hitherto studied material, including most of the BA samples from area 7685 and over 10% from area 7383. They appear nevertheless as outliers among the total scatter, provoking reflections on their functional and taphonomic background.

Bronze Age feasting remains?

By the presence of contemporaneous samples with a much more balanced composition, it becomes clear that the predominance of caprines is not necessarily representative for the general economic background of the different stages of the BA. Rather, these assemblages can be understood as the result of a special depositional environment where a highly regular type of consumption and deposition occurred. Apart from the pottery accumulations, this is also indicated by the skeletal part distribution, indicating a fair representation of meat-bearing elements, and the high frequency of butchery marks (Fig. 10.9). At least for the assemblage of the surface *locus* 7685:142, identified as a primary deposit, an origin from a single (social) event was considered. Both original spatial relationships between bones, and between bones and ceramic objects, were apparently preserved. In taphonomic terms, these indicators of primary deposition put this assemblage at one end of a depositional continuum, where time-averaged, extended deposits stand on the other.

According to the faunal record, an interpretation as primary deposits can be extended onto spatially adjacent *loci*, if not to all *loci* exhibiting a similar distinct dominance of caprines. Even though most of these *loci* were defined as "deposits" in the project database, their sedimentary structure described in the excavation reports is different from those of the deposits from other areas.

Although their relationship to architectural units is partly obscured by the complex building history of the temple, these assemblages may correspond to those "not rarely occurring exceptionally rich indoor contexts" mentioned by Marom and Bar-Oz (2013: 233). The better preservation of small and delicate remains within architectural units, as opposed to open spaces, is a commonplace in Roman and medieval zooarchaeology as well (Chaix and Méniel 2001: 156).

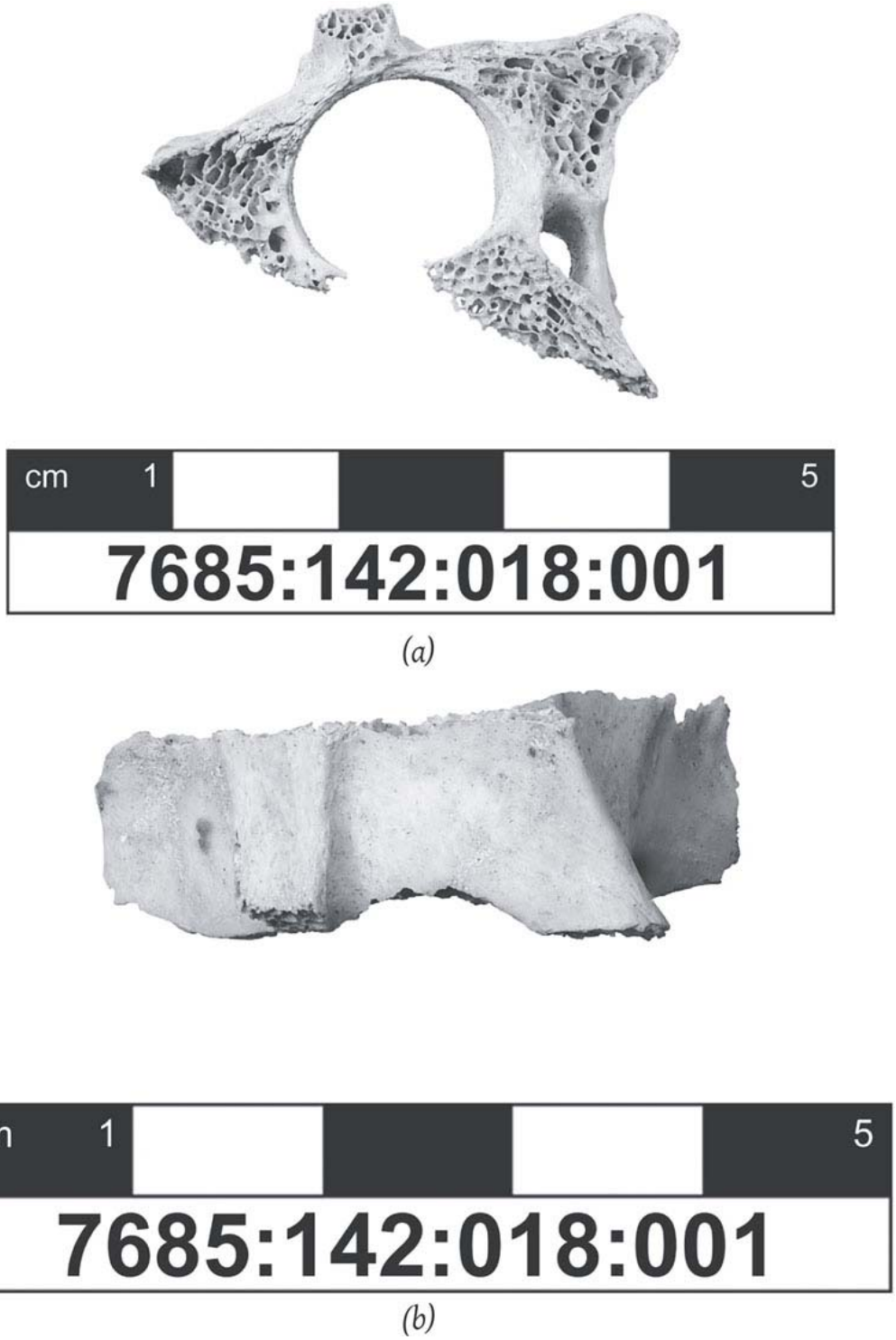

Fig. 10.9. Butchered cervical vertebra from sheep or goat, locus 7685:142; a) cranial, b) ventral aspect; probably the same vertebra is visible in Fig. 10.5 (photograph by H. Marquardt, Oymaağaç-Nerik project database).

Apart from feasting, any activity likely to produce de-facto monospecific assemblages, such as animal sacrifice, specialised butchery or provisioning may be held responsible. Especially communal feasting in ritual contexts bears the potential to produce large, homogenous and highly structured assemblages (Kunst 2013; Lentacker *et al*. 2004).

A thorough analysis of skeletal part representation and butchery marks will also contribute to their

better understanding and could make clear if they share a common depositional history. It may be tempting to look at them as an indicator of "urbanity", produced by an organized community, as opposed to the more "general" faunal pattern of the IA. A few IA samples, notably deposit 7389:22, may exhibit a pronounced dominance of caprines as well, but this does not become a general trend throughout a larger number of spatially related *loci*. Rather than the composition of individual samples, it is the dispersion of the data points observed within a period or area which may provide further insights. This dispersion is likely to express the degree of uniformity or heterogeneity within any analytical unit.

Sure, raised percentages of caprines alone are not indicative of a special assemblage nor of architectural spaces. For instance, the predominance of caprines (>80%) in a large, possibly time-averaged MBA deposit from an open area at Tel Hazor (Israel; Marom *et al*. 2014) is thought to reflect local consumption habits, setting this site apart from others with more diversified assemblages which result from varied architectural contexts.

Concluding remarks

Some of the differences between BA and IA assemblages from Oymaağaç may indeed be rather due to taphonomic than economic reasons, controlled by the different occurrence of feature types. However, it may be difficult to draw a clear line here. While differing percentages of cattle can be discussed along a centre-periphery cline, with higher amounts of cattle in peripheral contexts situated farther from buildings (Wilson 1996), there is no analogous way to explain for differences in the caprine–pig ratio. These exist between IA deposits and pits from area 7389, where they are based on a comparatively small sample as far as pits are concerned. Contrary to cattle, there is no uniform picture regarding pig ratios in the BA. They tend to vary between 10% and 20%, apart from the samples totally dominated by caprines.

Therefore, the extreme caprine predominances, as long as pigs remain elements of the local system, cannot be explained by size-sorting, or other taphonomic processes alone, but point at intentionally created assemblages. They may belong to the category of "anomalous sites" (or better assemblages) as defined by Hesse (2011), reflecting a deliberate choice for sacrifice, feasting or any other ritualized or structured activity.

Comparisons with Hattuša-Boğazköy (von den Driesch and Pöllath 2004) permitted only limited insights. The samples from this site are based on summaries for the different periods and exhibit high cattle percentages throughout. Rather than due to fundamental economic differences from Oymaağaç, the conformity among the Hattuša samples, which mostly encompass large materials, points at different taphonomic settings, or at differing considerations in the course of collecting and analysing the animal bones. At Hattuša, these derive from various building structures, pits and silos, and the data points represent averages from various areas and contexts of this vast site. Most likely, peripheral areas of the city, where large amounts of material could accumulate, were included, which would decisively determine the composition of period summaries. Due to the small-scaled environment at Oymaağaç and to the choice of excavation areas, these types of deposits, with the exception of the MBA and the IA, are either not present or preserved *a priori* or have not been studied yet. Moreover, clear-cut caprine dominances have not been reported for the sample means from Hattuša, which does not exclude their potential existence within individual contexts. A parallel between the two sites concerns the low

caprine percentages in the IA. At Gordion (Zeder and Arter 1994), caprine predominance was also observed among summarized means for certain periods, and the overall dispersion of the respective data points, including both BA and IA periods, largely coincides with those for the BA from Oymaağaç. This may be linked to the fact that at Gordion, most of the material was collected from residential areas. However, the diachronic development of the composition of the triad of these two sites does not go conform. This could also mirror a reversed trend in site function: at Gordion, the highest level of urbanity is only reached in the Phrygian period of the IA.

The overall dispersion of summarized data points, including both BA and IA, appears greater at Oymaağaç than at Hattuša (Fig. 10.7 (d)) and Gordion. Conceivably, this very dispersion is also correlated to the degree of splitting of the analytical units and to sample size. At Oymaağaç, means of periods were calculated separately for each area, and specimen counts of these samples vary between 150 and 1,250. The more a material is broken down into individual units, the wider the dispersion of data points is to be expected, because outliers are no longer balanced out. It is otherwise especially at the area level (Fig. 10.7 (a)–(c)) that the distribution patterns of the data points were found to be most inspiring for a comparative evaluation of the assemblages.

It is evident that some structured relationships between excavation data and faunal remains can be recognized at Oymaağaç, even if a coarse method like the composition of the domestic triad is applied, and the amount of contexts studied so far is limited. To study the basic variability of these main components appears as a first step towards an understanding of the consumption and disposal practices prevalent across a complex, multi-period settlement site.

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Chapter 11

Every Dog has Its Day: Cynophagy, Identity and Emerging Complexity in Early Bronze Age Attica, Greece

Angelos Hadjikoumis

Our knowledge of societies in transition from the Neolithic to the Early Bronze Age in Attica is almost non-existent on issues related to human-animal interactions. This constitutes the first study of three large faunal assemblages from southeast Attica that sheds light on a variety of previously unaddressed issues revolving around the notions of identity and social complexity. Zooarchaeological analyses reveal that the practice of cynophagy played an important role in Early Bronze Age Attica. Dogs were systematically reared and consumed as suggested by the abundance of their remains, the extensive butchery marks on them and other lines of evidence. Cynophagy occurred in Greece from as early as the Early Neolithic and there is evidence for it from various regions but the case of Koropi in Attica is perhaps currently the most characteristic example of an extensive and organized adherence to this practice in Early Bronze Age Greece. Moreover, this study produced evidence to support that cynophagy was not practiced for purely subsistence purposes and discusses the possible sociopolitical ramifications of this practice in the currently available archaeological context of Early Bronze Age Attica.

Introduction

Archaeological context

Despite intense archaeological interest in the Bronze Age of Greece, our knowledge remains patchy both in chronological and geographical terms. The Middle and Late Bronze Ages (*i.e*. 2nd millennium cal BC) with the impressive Minoan and Mycenaean civilizations are better-known than the preceding Early Bronze Age (*i.e*. 3rd millennium cal BC, hereafter "EBA"). For the EBA, some regions are well-covered by archaeological research, such as the Peloponnese and the Cyclades, while Attica, and especially its southeastern part (Fig. 11.1), remains poorly known archaeologically and entirely unknown zooarchaeologically. During the preparations for the 2004 Olympic Games in Athens and prior developments in southeast Attica, extensive construction works brought to light many EBA, as well as later Neolithic, settlements. The large volume of material excavated within a few years and the

dire financial straits, subsequently afflicted Greece, have delayed the study of many archaeological – especially zooarchaeological and archaeobotanical – assemblages.

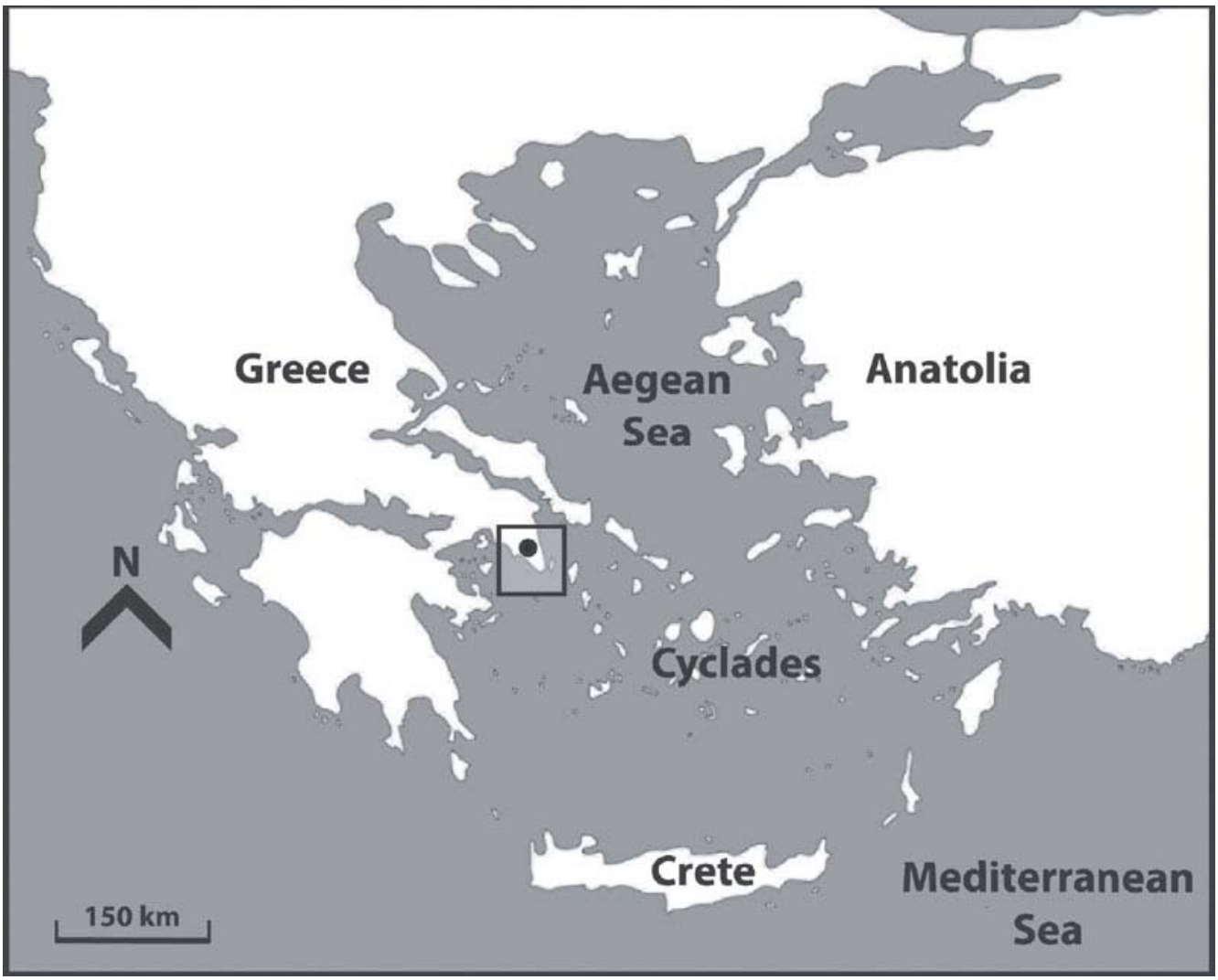

Fig. 11.1. Map of Greece and the Aegean with the area of study indicated by the black square and the cluster of Koropi sites by the black circle.

The EBA in central and southern Greece appears to have been a period of settlement expansion, both in the number and distribution of sites and in the spatial extent of some of these (*e.g.* Rutter 1993, 2001). Moreover, several Late Neolithic and EBA sites in northern and central Greece have yielded evidence for large-scale consumption events (Halstead 2004, 2012), which imply greater socioeconomic complexity than in earlier Neolithic contexts (Pullen 1992, 2011). Similar patterns are observed in Crete (Isaakidou 2004), the Cyclades (Broodbank 2000) and increasingly in Attica, although different *circum*-Aegean areas followed distinct trajectories towards complexity (*e.g.* Whitelaw 2004: Fig. 13.7). This dynamic context probably boosted contacts between Attica and other areas of southern mainland Greece, as well as between mainland Greece, the Cyclades and Crete.

Human–animal interactions are not as well-known as other lines of archaeological evidence, although some regions are represented by quite large assemblages. Large EBA faunal assemblages were recovered in the Peloponnese at Lerna (Gejvall 1969) and Tiryns (von den Driesch and Boessneck 1990), while that from Tsoungiza (Halstead 2011) is of modest size but has the advantage of more

systematic recovery. At these sites, domestic animals form the overwhelming majority while wild species played a minor role with percentages well below 10%. The more fragmented state of the bones of wild animals at Lerna (Gejvall 1969) implies more intensive processing for consumption, one explanation for which has been increased reliance on hunting during times of restricted availability of domestic resources (Halstead 1987). Due to lack of sieving in the old excavations at Tiryns and Lerna, detailed comparisons between sites are unreliable but in broad terms the three sites appear to be similar with sheep/goat around 45% (with variable sheep *vs*. goat proportions), pig around 30% and cattle 15–20% (Halstead 2011: table 13.54). EBA Lerna also provides some of the earliest evidence for the introduction of domestic equids in Greece. The importance of each domestic species in these three Peloponnesian assemblages is broadly similar to that at EBA sites in central Greece such as Pevkakia (von den Driesch 1987) and Platia Magoula Zarkou (Becker 1991). The importance of hunting, however, seems to increase from south to north, with percentages of hunted species regularly exceeding 10% at sites in central and northern Greece (Halstead and Isaakidou 2013: table 7.4). EBA assemblages from the Cycladic islands (*e.g*. Emporio on Chios, Phylakopi on Melos and Zas cave on Naxos) exhibit an overwhelming majority (60–90%) of sheep and goat, which may be attributable to environmental constraints of limited land area, rugged terrain or low rainfall (for summary of assemblages see Halstead 1996: table 1 and references therein). In Crete there is a scarcity of EBA assemblages but the largest available from Knossos is more reminiscent of Cycladic than mainland Greek assemblages (Isaakidou 2004).

For southeast Attica, the geographical focus of this paper, recent rescue work has located and exposed several EBA settlements of varying sizes and, apparently, function (Andrikou 2013b, in press; Kakavogianni and Douni 2009; Kakavogianni *et al*. 2009a, 2009b), showing that a seemingly empty archaeological map represented lack of investigation rather than the absence of human habitation. From available excavation reports and a few specialist studies, evidence is now emerging from southeast Attica of settlement diversity, large-scale communal works (*e.g*. Andrikou 2013b; Kakavogianni 1986), rich material culture (*e.g*. Andrikou 2013a; K. Douni personal communication), trade with the wider Aegean world and extensive metallurgical activity (Kakavogianni *et al*. 2008). Although analysis and interpretation are at a preliminary stage, these new discoveries from EBA southeast Attica highlight the dynamic cultural context of the three faunal assemblages presented in this study.

Cynophagy in Greece

When exploring identity in past societies, zooarchaeologists usually focus on evidences of practices that are out of the ordinary. These differences in diet between regions or periods are frequently viewed as reflecting aspects of the identity of a particular cultural group or sub-groups. One such practice is cynophagy, for which ample evidence has been found in the three EBA assemblages discussed below. Since consumption of dogs (in contrast to cattle, pig and caprines) was not ubiquitous in Neolithic and Bronze Age Greece, abundant and regular evidence for this practice could be interpreted in terms of (sub-)group identity. Before proceeding to analysis of the data from EBA Koropi in Attica, it is useful to provide an overview of available information on cynophagy in prehistoric Greece.

Trantalidou's (2006 and references therein) study on the role of domestic dogs in Greece from the Aceramic Neolithic to the Classical period provides a good starting point. Before the Mycenean period,

entire dog skeletons were absent from funerary contexts and most commonly excavated either in general settlement or refuse contexts. It is clear that the domestic dog was present, albeit in small numbers (below 1%) at all three listed Aceramic Neolithic sites from central Greece, the Peloponnese and Crete (Trantalidou 2006: table 1). In the Early Neolithic, for which evidence is available from more sites covering most of mainland Greece and Crete, the scarcity of dogs continues (below 2%). In the Middle Neolithic, percentages remain low, with the exception of the site of Dimitra in east Macedonia, where dogs make up 14.7% of an admittedly modest assemblage (NISP=319) in phase Ia and 5.3% in phase Ib (NISP=425) (Yannouli 1997: table 2a). Exact quantification of butchery marks on dog remains from Dimitra is not available but Yannouli (1997) confirms their presence and infers cynophagy at the site also on the basis of the similarity in contexts and state of fragmentation between dog and other domestic species. In the immediately subsequent Late Neolithic period at Dimitra (NISP=672), dog percentages remained relatively high (5.6%). Relatively high dog percentages have also been recorded at a few more Late or Final Neolithic sites, such as Thermi B (6.8%, Yannouli 1992) and Stavroupoli (4%, Yannouli 2002) in Macedonia and Dimini (4%, Halstead 1992) in Thessaly. Evidence for cynophagy at these sites is scarce (*e.g.* occasional butchery marks) or non-existent, however, and for some (*e.g.* Thermi B and Stavroupoli) it has been argued that dog was probably not consumed, mainly because its remains were found in a less fragmented state than those of other undoubtedly consumed species such as sheep, goat, pig and cattle (Yannouli 1992). In Trantalidou's study (2006: table 1), besides the sites mentioned above, 13 further Late Neolithic sites from northern, central, southern and insular Greece are listed with dog percentages consistently below 3% and usually below 1%.

During the EBA – the chronological focus of the present study – dog percentages remain steadily below 4% all over Greece. The early Middle Bronze Age sample from Nichoria produced an intriguing 8.6% of dog (based on MNI), but closer examination of its zooarchaeological study (Sloan and Duncan 1978) reveals that dog percentages may have been exaggerated in the calculation of MNI: although only 19 dog specimens were identified, these were translated into an MNI of 17 dogs. Despite the probable exaggeration of dog abundance for Middle Bronze Age Nichoria, evidence for cynophagy was reported in the form of "many burned and cut dog bones …" (Sloan and Duncan 1978: 69).

Although the percentage of dog in a faunal assemblage alone neither confirms nor precludes cynophagy, it is indicative of its relative importance at each site. In the zooarchaeological literature on Neolithic and EBA Greece, cynophagy appears to have been relatively widespread in mainland Greece and the larger Aegean islands (*e.g.* Bökönyi 1989; Gejvall 1969; Isaakidou 2007; Trantalidou 1996; Yannouli 1997). Intriguingly, however, not all assemblages of these periods yielded evidence for cynophagy, suggesting that it was not ubiquitous. The importance of cynophagy varies from site to site and from period to period. Geographically, besides the presence or absence of evidence for cynophagy at each site, there is no clear regional pattern, other than higher dog percentages at some sites in northern Greece which might be attributable to the apparently greater frequency of hunting. Temporally, there is a trend towards higher dog percentages in Late/Final Neolithic and EBA sites.

Aims and objectives

The main aim of this study is to present the evidence for cynophagy in EBA southeastern Attica based on species composition, the age-at-death of dogs, the frequency and type of butchery marks on dog remains, as well as relevant aspects of their taphonomy and fragmentation. The data derive from the

study of three faunal assemblages from southeast Attica. Beyond this main aim, a glimpse is provided of the previously unknown EBA animal economy in this area (to be discussed in greater detail elsewhere – Hadjikoumis *et al*. in prep.). An attempt is then made to place the evidence for human-dog interactions in EBA Attica in the context human-animal interactions and other archaeological trends for Attica and more generally for Greece.

Materials and methods

This study focuses on three EBA assemblages from the municipality of Koropi in southeast Attica (Fig. 11.1). Despite the fact that the three assemblages represent samples from different sectors of the same EBA settlement, they are treated separately in this study because they were excavated at different times by different excavators and research on most of the excavated materials as well as the integration of the data collected is still in progress. Moreover, the possibility of minor chronological or functional differences between them remains open. The three excavations are Koropi-Medical Center (hereafter "KMC"), Koropi-Papachristou ("KP") and Koropi-Thanou ("KT"). KMC (Kakavogianni 1986, 1989) constitutes the northeast and KP and KT (Andrikou in press, 2013a, 2013b) constitute the west sector of the EBA settlement at Koropi. The obvious spatial relationship between them is taken into account in the discussion of the results. The material from KMC was recovered from a series of five large subterranean chambers (1, 2, 3, 4–5, 6) and a well. The chambers are cut into the soft calcareous bedrock, are oval in shape and of monumental size by EBA standards (the largest being 10 m long × 6.50 m wide × 3 m deep), and contained large volumes of pottery and animal bones. The chambers have been interpreted as underground storage facilities that were subsequently filled with waste from the settlement (Kakavogianni 1986, 1989). Around the chambers, remains of a wide street and remnants of buildings were also uncovered, although the faunal remains recovered from these contexts were too sparse for any reliable analysis.

Excavation of KP and KT in the southwest of the settlement revealed roads and clusters of rectangular stone-built houses. Based on the typology of pottery and other material culture, all three assemblages are dated to the EBA (*i.e*. Early Helladic II, from 2,800 to 2,300 cal BC) (*e.g*. Andrikou 2013a; K. Douni pers. comm.). Minor chronological differences between the assemblages and also between contexts within each site cannot be excluded, but for the purposes of this study and not least because the analysis of many other materials is still in progress, the three assemblages may be considered broadly contemporary.

The anatomical units selected for systematic recording are: horncore bases; mandible/loose cheek teeth; atlas; axis; scapula; proximal and distal halves of humerus, radius, femur, tibia, metapodia (only III and IV in pigs, II–V in canids); proximal half of ulna; pelvis; astragalus; calcaneum and phalanges 1–3 (excluding lateral phalanges in pigs and phalanges of metapodium I in canids). These anatomical elements have been selected for their durability, identifiability and potential to provide information on the human-animal relationship. For the quantification of species composition, age-at-death and biometry the minimum numbers of anatomical units (MinAU) is used, while for butchery the maximum numbers of anatomical units (MaxAU) is preferred, both according to Halstead (2011). In the same publication, a definition of this quantification method is provided:

> "MinAU was estimated as follows. When two or more fragments might be derived from the same anatomical unit (e.g., a single left proximal tibia) of the same individual animal, only the most complete

example contributes to the minimum number of anatomical units. Similarly, to simplify comparison between species with different numbers of foot bones, quantification of fragments of metapodial bones and phalanges has been standardized in terms of minimum numbers of feet: thus if two specimens of phalanx 2 of, say, sheep (or sheep/goat) could be derived from the same foot, only one contributes to the MinAU. Assessment of MinAU was based on visual comparison of specimens and involved the strewing of anatomical/taxonomic groups (e.g., pig humeri) into subgroups (left/right, proximal/distal, medial/lateral, fused/unfused, etc.)."

As with the calculation of minimum numbers of individuals, quantification in terms of MinAU requires an archaeological (rather than zooarchaeological) judgment as to which bone groups are sufficiently close in date of deposition to justify searching for notional "joins" between fragments (Halstead 2011: 749–740).

The MinAU/MaxAU method of quantification was preferred for several reasons. Most importantly, MinAU helps avoid an overestimation of certain species and anatomical elements due to extreme fragmentation (*e.g*. of sheep/goat mandibles or tibiae resulting in many easily identifiable fragments belonging to the same specimen). MinAU does not include two or more identified specimens which could potentially derive from the same unit (*e.g*. a left distal half of humerus). MaxAU is similar to NISP except that it does not include some parts of the skeleton (see above) and it divides long bones into proximal and distal halves. Quantification in terms of MinAU/MaxAU allows reliable comparison with several other zooarchaeological studies in Greece that have followed the same methodology.

Results

Overall species composition

In the largest assemblage of KMC (Fig. 11.2), sheep and goat are the most abundant (53.1%), with slightly more sheep than goat, while cattle (18.3%) and pig (17.5%) are both less frequent. A single equid maxillary tooth provides tentative evidence for the introduction of equids into Attica during the EBA. Perhaps the most surprising characteristic of the KMC assemblage, however, is the high percentage (10.4%) of dog. Dog remains are most abundant in chamber 1 (MinAU=588, 21.9%) and 6 (MinAU=719, 15.0%). The sparse remains of wild animals include several species: red deer, roe deer, fox, and possibly wild boar and wolf.

The species composition of KP is broadly similar to that of the KMC with slightly more than half of the assemblage belonging to caprines and with sheep slightly more abundant than goat within that category (Fig. 11.3). Cattle are slightly less and pigs slightly more abundant than in KMC, while wild species are again scarce. Most strikingly, dog remains are relatively infrequent (2.5%) in KP.

At KT (Fig. 11.4) species composition is similar to that at KP in the predominance of caprines (65.8%) and, lesser abundance of pig (16.4%) and cattle (9.3%), but in this case goats are slightly more abundant than sheep and higher percentages of wild species are also observed. Dog percentages are intermediate between those observed in the other two assemblages (4.6%).

Dog age-at-death

The age-at-death of dogs from the three assemblages is explored on the basis both of epiphyseal fusion and of dental eruption and wear. The dog is a relatively fast-maturing carnivore with most postcranial elements fusing before the end of the second year (Silver 1969) and the estimation of age at death

based on dental wear is only approximate (Horard-Herbin 2000). Nevertheless, since dog was abundant at EBA Koropi and possibly consumed, it is important to explore the evidence for age at death. For the analyses, dog postcranial remains were divided into elements that fuse before 12 months of age and those that fuse within the second year.

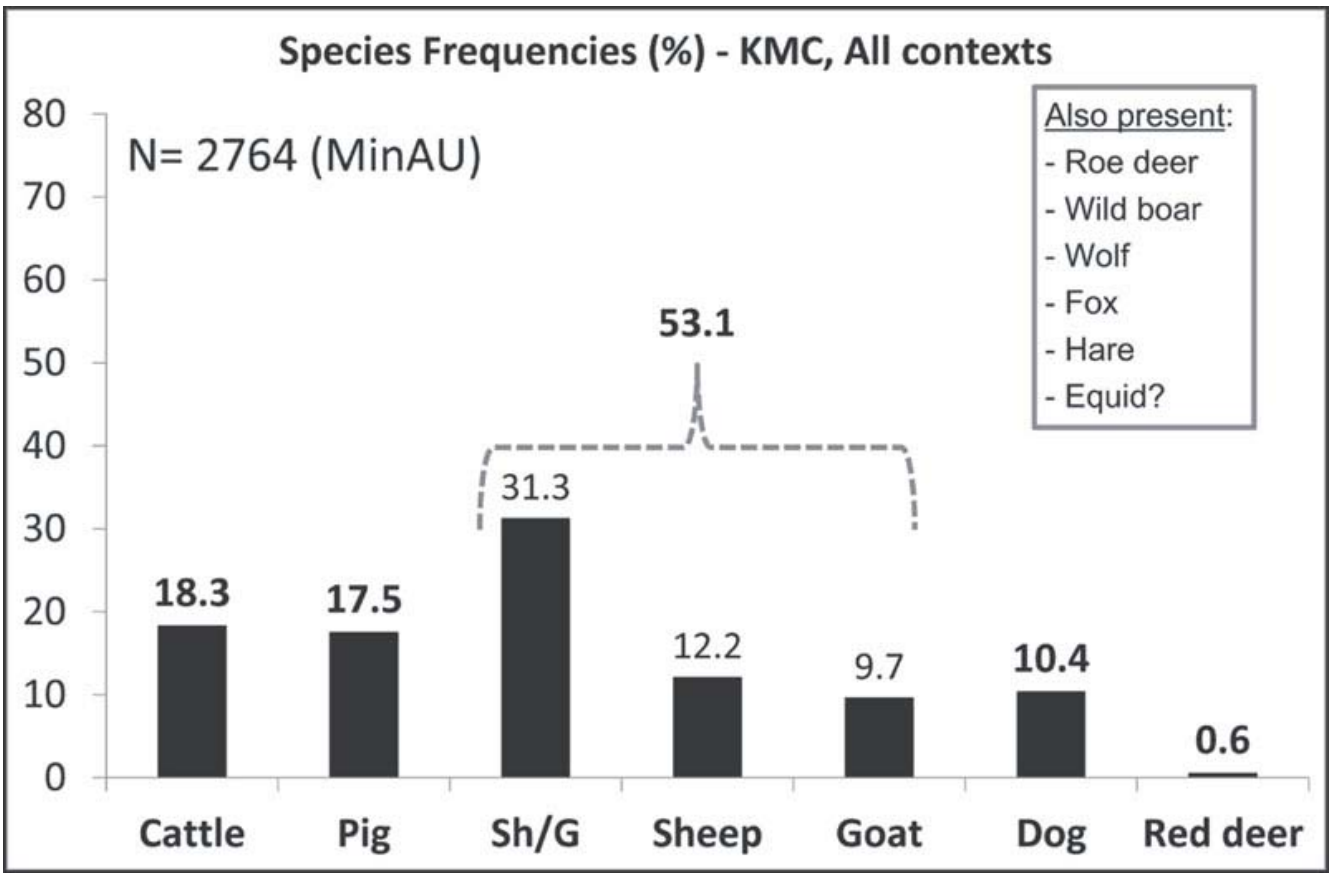

Fig. 11.2. Species composition at KMC, all contexts combined. Specimens belonging to species reported simply as present (see box to the right of graph) are excluded from the total MinAU and the calculation of frequencies for the more common species. Horncores and antlers have also been excluded to ensure comparability with species that lack those elements.

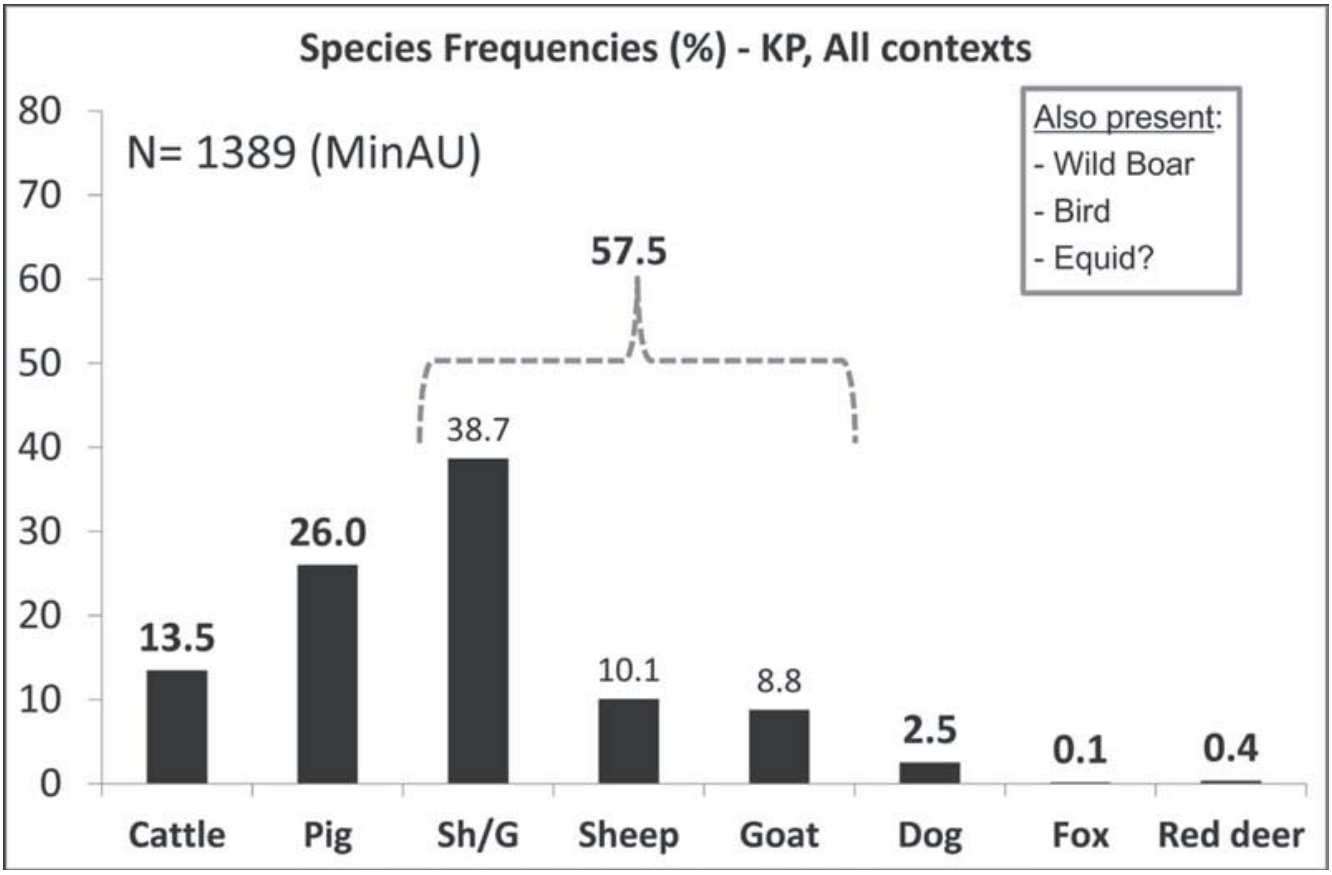

Fig. 11.3. Species composition at KP, all contexts combined. Specimens belonging to species reported simply as present (see box to the right of graph) are excluded from the total MinAU and the calculation of frequencies for the more common species. Horncores and antlers have also been excluded to ensure comparability with species that lack those elements.

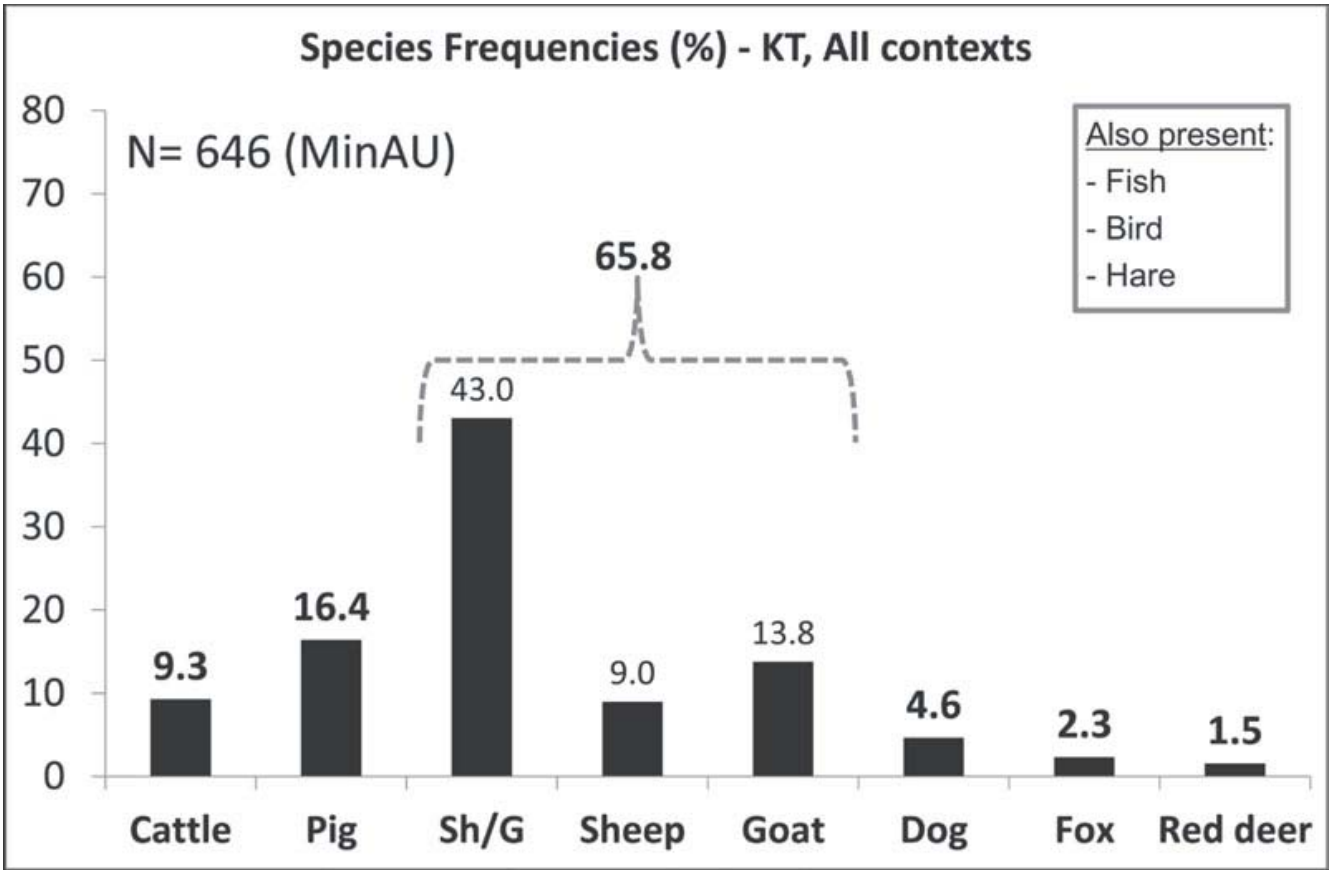

Fig. 11.4. Species composition at KT, all contexts combined. Specimens belonging to species reported simply as present (see box to the right of graph) are excluded from the total MinAU and the calculation of frequencies for the more common species. Horncores and antlers have also been excluded to ensure comparability with species that lack those elements.

Starting with the epiphyseal fusion data from the largest assemblage of KMC, it is clear that only 5% of dogs died during their first year with mortality rising to 27% in the second year (Fig. 11.5). Interestingly, there are differences in age at death of dogs between contexts. In chamber 6 (Fig. 11.6), there is a clear trend towards younger age at death with higher levels of mortality in both the first (11%) and the second year (44%). If chamber 6 is excluded from analysis, then mortality drops to 3% in the first year and 18% in the second.

At KP, dog remains were scarce and thus not amenable to reliable epiphyseal fusion analysis. Nevertheless, the scarce data suggest that most dogs survived their first (12/12 elements fused) and second (3/3 elements fused) years. The sample of aged dog postcranial remains from KT is slightly larger (N=18) and reveals a similar trend to that of the large sample from KMC, with no deaths in the first year but 27% mortality during the first half of the second year.

The abundant dog remains from KMC allow another approach to the age-at-death based on mandibular eruption and wear. The analyses were carried out based on the Horard-Herbin (2000) scheme, with an additional category for neonatal mandibles. The results (Fig. 11.7) reveal a peak at stage D, which is the most common wear stage for dogs 15–24 months old according to Horard-Herbin (2000: table 1 and fig. 4). Most of the rest of the mandibles belong to earlier stages (A, B, C and neonatal) with only dogs belonging to the last two stages (F and G). Despite the well-known problems of assigning age to dog teeth due to the broad variability in the abrasiveness of their diet, the trend in

this assemblage is clear. The vast majority of dogs died at a relatively young age (*i.e*. 1– 2 years). Very few dogs lived beyond the third (11.4%) or fourth (5.7%) year with an intriguing gap at stage E, which would represent dogs mostly of 2–3 years of age. In addition, some of the oldest specimens are also some of the largest and hence might represent wolves or dogs selected for particular purposes (*e.g*. protection against predators).

Basic biometry

The most abundant anatomical unit was the distal humerus and the scatterplot of its distal breadth and height of trochlea reveals a relatively tightly bound cluster of measurements and few distinctly large outliers (Fig. 11.8 and Table 11.1). This pattern suggests that the dog remains from the three assemblages at Koropi probably belonged to a single type (*i.e*. the majority of specimens clustered together) while the two particularly large specimens probably represent wolves. Some variability observed within the dog remains can be attributable to sexual, age-related or individual variability within this dog population. The withers height for the Koropi dogs, estimated (Harcourt 1974) from the greatest lengths (*sensu* von den Driesch 1976) of four humeri, three radii and one femur (Table 11.1), ranged between 47 cm and 54 cm.

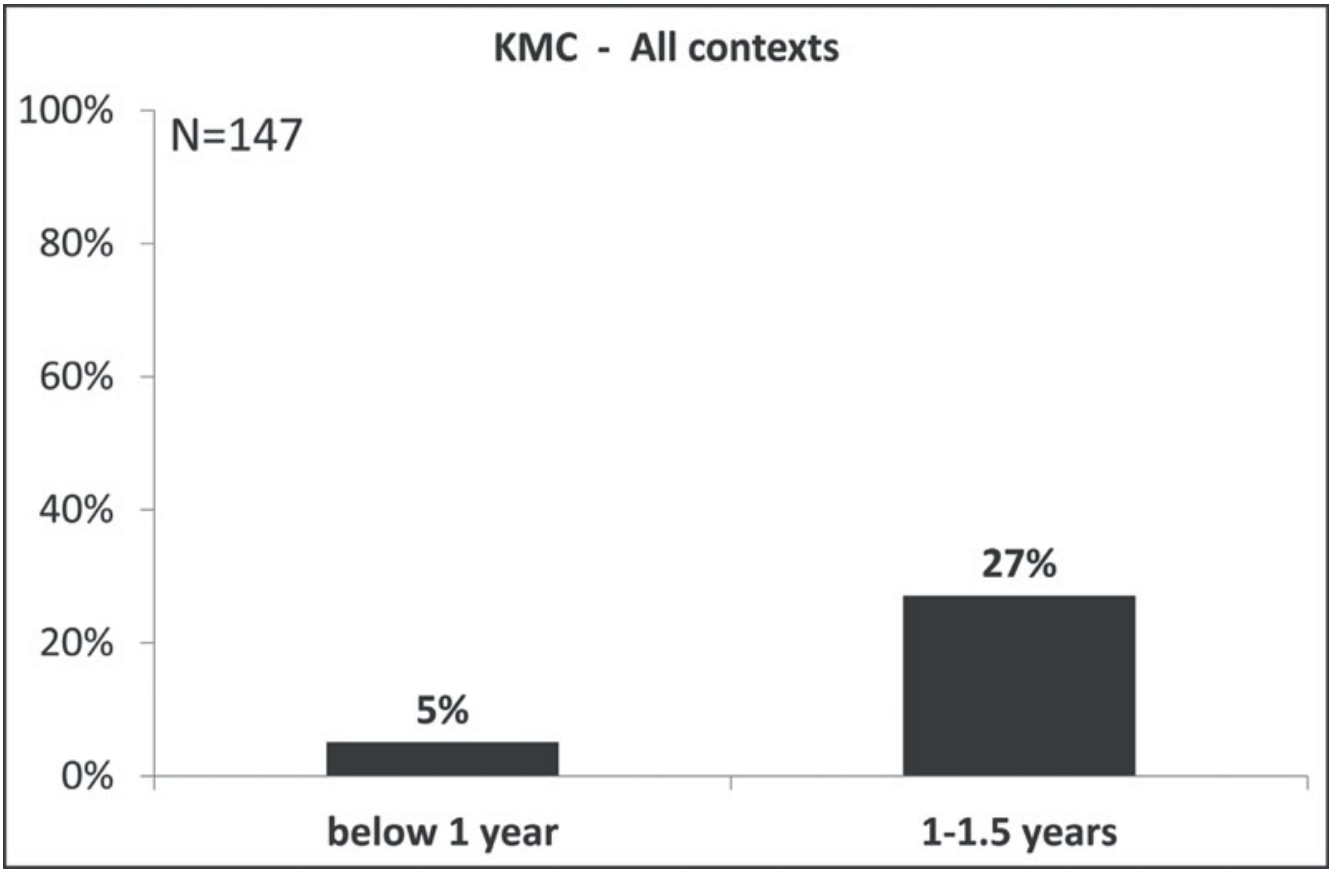

Fig. 11.5. Percentages of dog mortality at KMC based on epiphyseal fusion, all contexts combined.

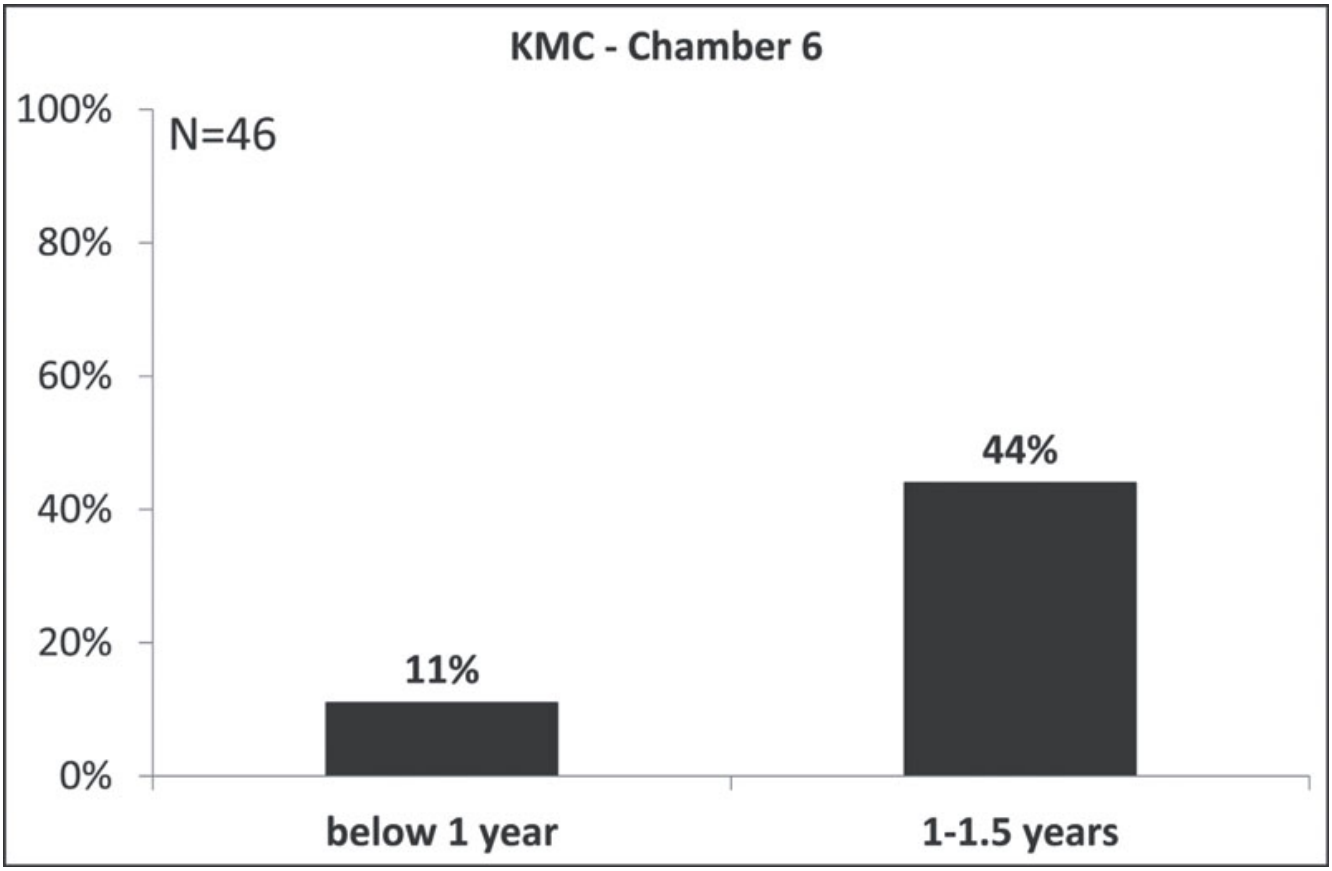

Fig. 11.6. Percentages of dog mortality at KMC based on epiphyseal fusion, only for Chamber 6.

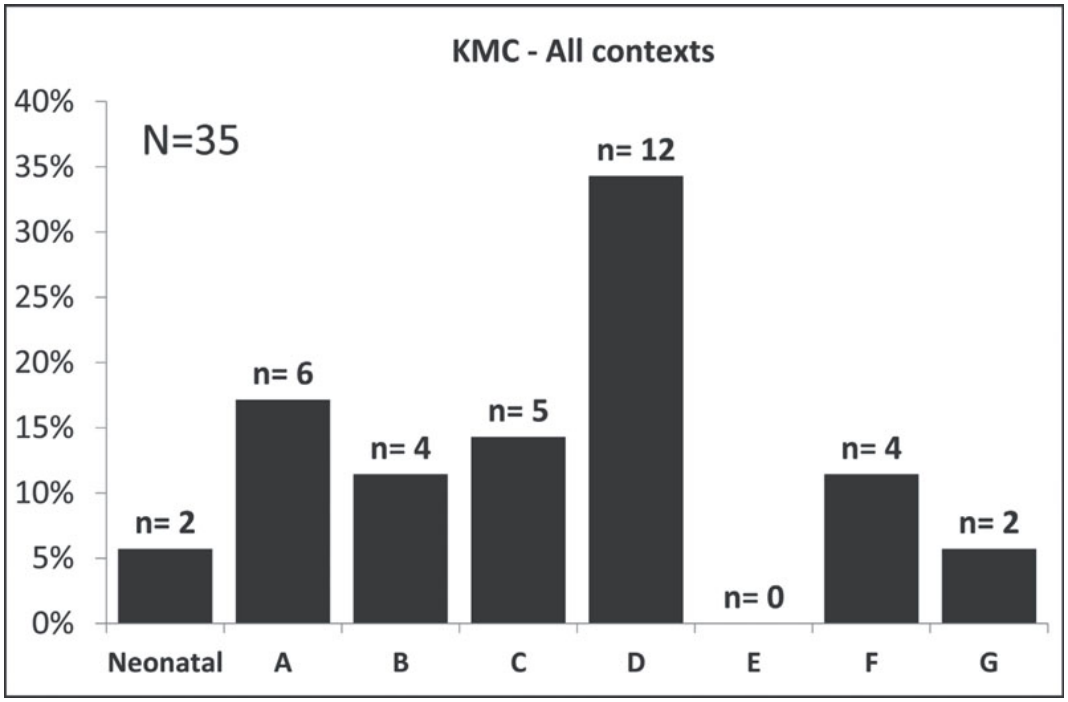

Fig. 11.7. Percentages of dog mortality at KMC based on mandibular eruption and wear. Wear stages are according to Horard-Herbin (2000) with the addition of the 'neonatal' category.

Butchery

The last but crucial category of data presented comprises the butchery marks on dog remains. The

percentages of remains that bear cutmarks show that dogs were butchered as intensively as the other domestic species (Fig. 11.9).

In terms of types of butchery marks recorded on dog remains, the only meaningful sample is that from KMC, where all main types of butchery (except working or sawing) are recorded for dog, as for the other common species (Fig. 11.10). The lower occurrence of chopping/hit marks and higher frequency of disarticulation marks compared to the other domesticates can be attributed to the smaller size of dogs, which renders less necessary any further butchering beyond disarticulation.

Discussion

The results presented in the previous section provide sound evidence for the practice of cynophagy in EBA Attica. Evidence for this practice has been previously reported from Neolithic and EBA sites in Greece, in the form of occasional butchery marks or high dog frequencies. Prior to this study, only a few sites in prehistoric Greece, mainly in the north of the country (*e.g.* Yiannouli 1997), have provided strong evidence for cynophagy, although small samples have hindered assessment of the extent and importance of the practice. The present study not only establishes that cynophagy was practiced in EBA Attica, but is based on samples large enough to shed light on its ramifications in that period and area.

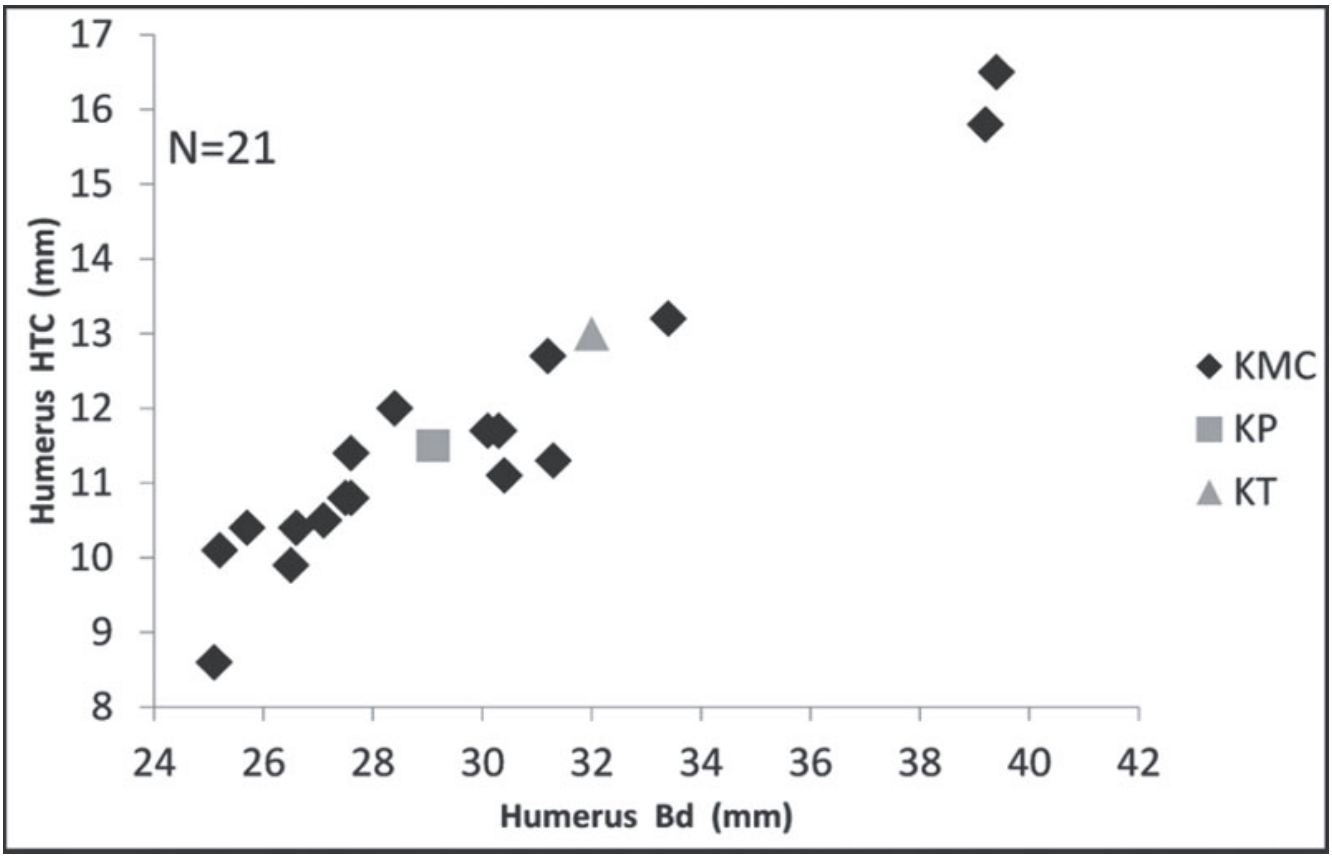

Fig. 11.8. Scatterplot of all measured fully fused canid distal humeri.

Table 11.1. Raw biometric data used in Figure 11.8 and the estimation of withers heights.

Site	Humerus			Radius	Femur
	Bd	HTC	GL	GL	GL
KMC	25.1	8.6		161.1	172.2
KMC	25.2	10.1		175.0	
KMC	25.7	10.4		176.0	
KMC	26.5	9.9			
KMC	26.6	10.4	146.2		
KMC	27.1	10.5	144.7		
KMC	27.5	10.8			
KMC	27.6	11.4	154.0		
KMC	27.6	10.8			
KMC	28.4	12.0			
KMC	28.4	12.0			
KMC	30.1	11.7			
KMC	30.3	11.7			
KMC	30.4	11.1	165.3		
KMC	31.2	12.7			
KMC	31.3	11.3			
KMC	33.4	13.2			
KMC	39.2	15.8			
KMC	39.4	16.5			
KP	29.1	11.5			
KT	32.0	13.0			

The notion that eating habits constitute an important component of cultural identity is well-established and extensively discussed in archaeology (*e.g.* Pollock 2012; Twiss 2007). Current zooarchaeological evidence from EBA sites in Greece suggests that cynophagy was not a ubiquitous

practice (Trantalidou 2006). Even in cases where some evidence for dog consumption is attested in the form of higher-than-normal dog abundance or cut-marks on dog remains, the extent and intensity of the practice varies from site to site. Independent of the exact meaning of cynophagy for the inhabitants of EBA Attica and more broadly of Greece, the fact that it was not ubiquitous and varied in intensity probably means that it was perceived by both consumers and non-consumers as an aspect of identity. The inhabitants of specific settlements or sub-groups within settlements that did not consume dogs at all, must have viewed others who did as somewhat different and *vice versa*, much as certain food taboos (including the consumption of dogs) are viewed nowadays by those who do or do not adhere to them.

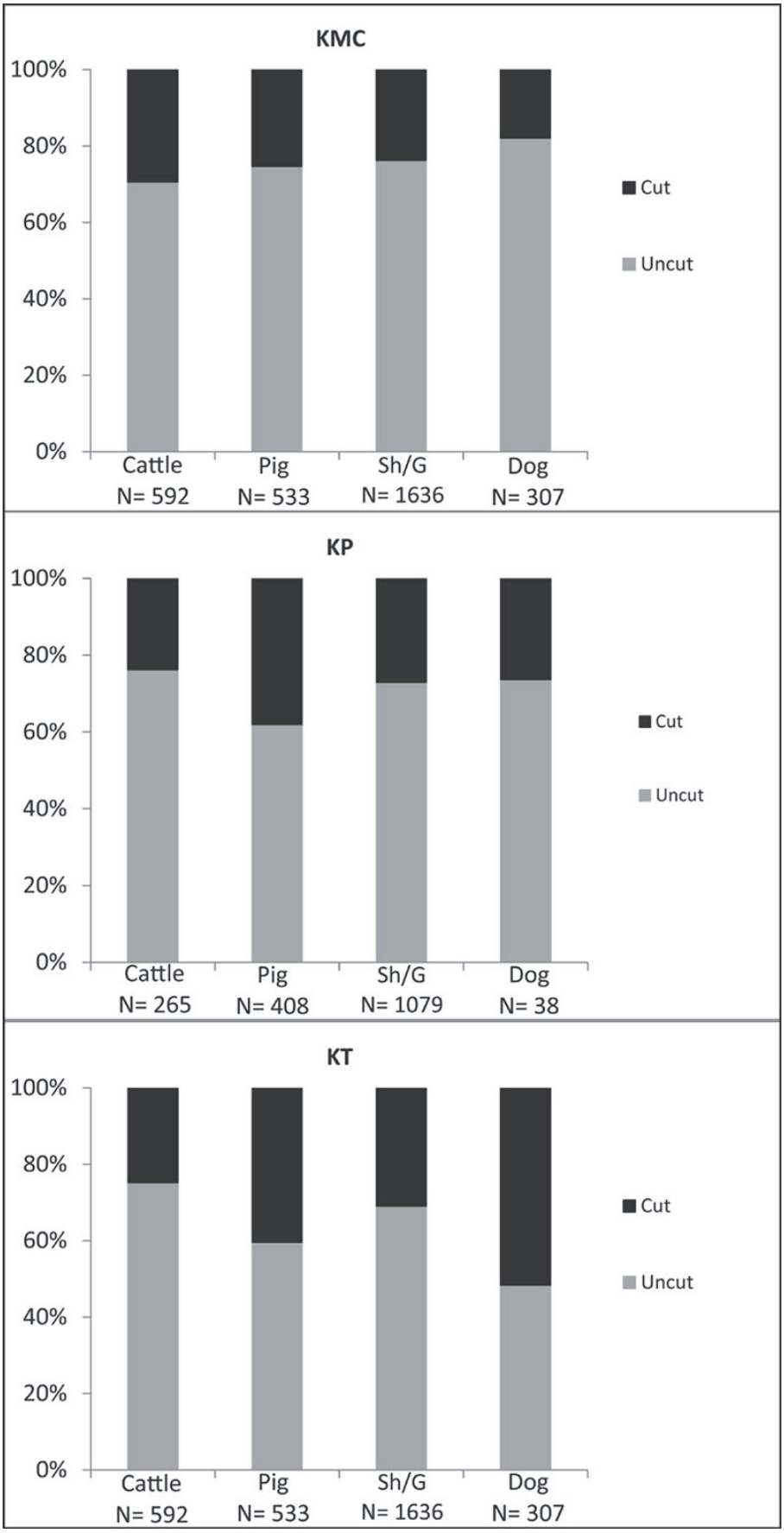

Fig. 11.9. Intensity of butchery on the remains of the most common species at KMC (top), KP (middle) and KT (bottom).

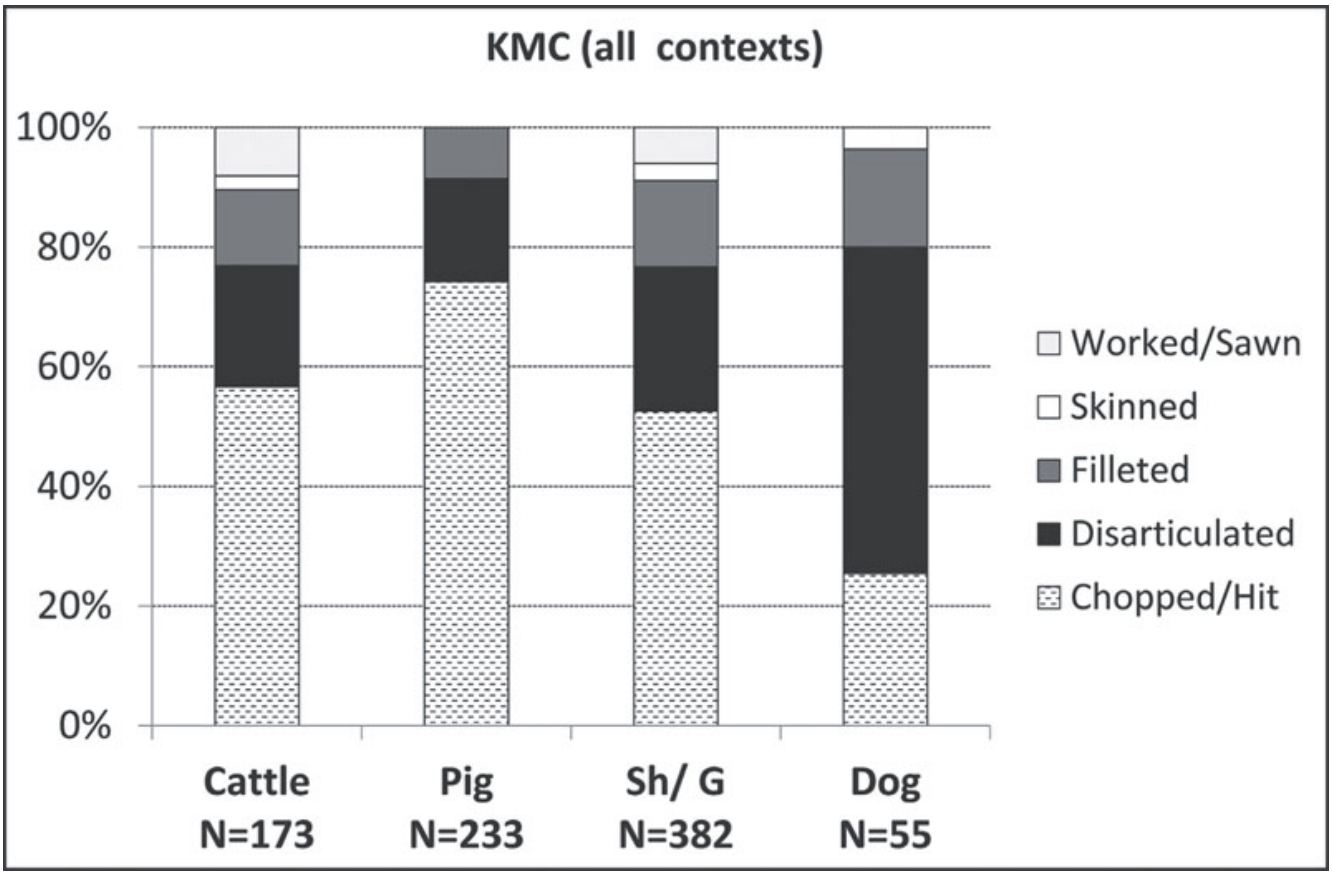

Fig. 11.10. Butchery types on the remains of the most common species.

Species composition in the three assemblages showed considerable variation in the abundance of dog remains (Figs 11.2–11.4). Dogs were significantly better represented in KMC, the area of the subterranean chambers (>10%), and especially in chambers 1 and 6 (15–20%). All three assemblages are dated by pottery to the Early Helladic II period (*i.e.* 2,800–2,300 BC) and are thus at least roughly contemporary. Assuming contemporaneity, the differences in dog percentages may reflect variation within the settlement in the use of space for particular activities. Whatever the original purpose of the subterranean chambers in the northeast of the settlement (KMC), they were eventually filled with waste, especially pottery, animal remains and obsidian. In contrast to KP and KT, the identification of joining old breaks in the animal bones and pottery from the subterranean chambers, as well as the large volume of tableware (K. Douni, pers. comm.), are suggestive of periodic consumption of food by large groups of people. This suggestion must remain tentative until analysis of the faunal and ceramic assemblages is completed. If such events did take place at EBA Koropi, however, then the consumption of dogs might have been related to a particular type (timing, rationale, social scale) of commensal occasion. The young age profile of the dogs consumed at Koropi (Fig. 11.7) is arguably more compatible with periodic and planned consumption of dogs than with enforced cynophagy (*e.g.* due to a famine), in which case the inhabitants of EBA Koropi would probably have consumed dogs of all ages and without such clear contextual variation within the settlement. The zooarchaeological data presented here suggest a system of rearing dogs, many of which were consumed at between one and two years of age. Beyond providers of meat, dogs at Koropi probably played additional roles such as guarding livestock, of which the most common species at Koropi, sheep and goat, would have needed protection from wolves and foxes, which are also documented in the faunal assemblages.

The biometric analysis shows that the dogs consumed at Koropi probably belonged to a single breed (Fig. 11.8) with withers heights around 50 cm. Dogs of this size were the most common "breed" in Greece from the Neolithic period to at least the Late Bronze Age (*cf*. Trantalidou 2006: table 6) and the same seems to have been the case over most of Europe during Neolithic and Bronze Age times (Horard-Herbin *et al*. 2014). Iconographic representations of dogs from EBA Greece are relatively rare but the closest, both geographically and chronologically, is the engraved outline of a dog on a pithos from EBA Askitario-Rafina, around 20 km northeast of Koropi (Fig. 11.11). A dog of those proportions and the size observed at Koropi could probably provide several kilograms of meat, though significantly less than even the smallest pigs or caprines. If we exclude cynophagy as a response to severe famine, the small meat yield of a dog compared to that of the other domestic species further supports interpretation of cynophagy at Koropi as having a primarily cultural rather than practical significance. Whether it was considered a culinary delicacy or had a more symbolic meaning is impossible to distinguish with the available data.

The way that dog carcasses were prepared and consumed sheds additional light on the practice of cynophagy in EBA Attica. The location and types of butchery marks show that dogs were skinned, dismembered and even filleted before they were consumed (Fig. 11.10). Traces of burning were quite rare (Hadjikoumis in prep.), suggesting that dogs were cooked in pots or ovens rather than open fire. There is thus no reason to believe that the preparation of dogs for consumption was different from that of other mammals. That disarticulation marks are more frequent, and those of filleting less frequent, may be attributable to the dog's smaller size compared to other domesticates and not to a radically different way of cooking. The less fragmented state of dog remains may likewise attributable to body size and certainly argues against their consumption as a response to famine and in favor of cynophagy as a cultural choice under normal circumstances.

In the broader context of EBA Greece, the evidence for systematic and regular cynophagy in Attica and most probably other regions of the *circum*-Aegean world deserves closer attention and improved integration with other lines of zooarchaeological and archaeological evidence. The archaeological record of EBA Attica shows strong indications of extensive trading with other parts of the Greek mainland and also with the Cyclades (*e.g*. Kouka 2008; Nazou 2010), the introduction of important technological innovations such as metallurgy (*e.g*. Gale and Stos-Gale 2002; Kakavogianni *et al*. 2008, 2009a), the emergence of larger settlements with communal spaces and streets accompanied by architectural innovations (*e.g*. Andrikou 2013b; Kakavogianni and Douni 2009; Kakavogianni *et al*. 2009a), as well as a more diverse and elaborate suite of mobile material culture such as pottery (*e.g*. K. Douni, pers. comm.). In such a context, it is easy to imagine how cynophagy, as a practice that was neither ubiquitous nor of uniform intensity between sites, may have become an attractive component of an emerging elite's 'choreography' of social life (Halstead 2012). The consumption of dog meat on a *supra*-household level, is supported zooarchaeologically by the large quantities of dog remains in specific contexts in the settlement at Koropi, by the non-intensive processing of dog carcasses and by the highly structured age profile of the dog population. What remains unknown based on currently available data is whether cynophagy at EBA Koropi was practiced at a community, *supra*-community or sub-community level. Whatever the answer, cynophagy may be considered an important aspect of local identity. In the future, additional data should help address more detailed issues concerning cynophagy in EBA Greece and elucidate the role that this practice played in the emerging complexity

of the Aegean world in the 3rd millennium cal BC.

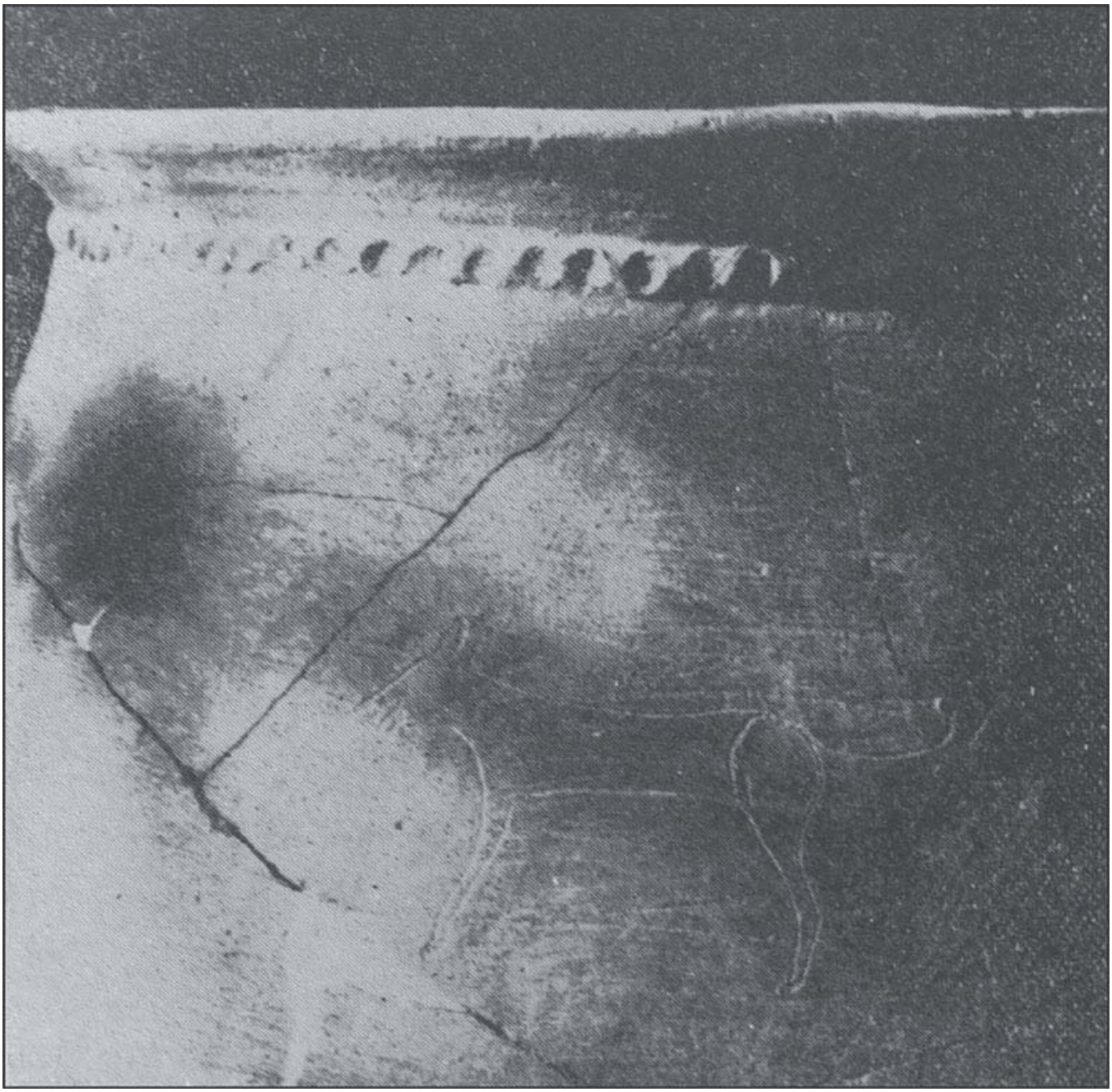

Fig. 11.11. Outline of a dog engraved on a pithos from EBA Askitario-Rafina (source: Theocharis 1954: fig. 8).

Conclusions

Cynophagy is a practice that deserves more attention and detailed study if we are to achieve an understanding of its origins, development and shifting significance through Greek prehistory. This study, based on sound evidence, establishes that cynophagy was relatively common in EBA Attica and more broadly in Greece. Moreover, the evidence strongly suggests that cynophagy was practiced in a systematic way and under 'normal' circumstances, instead of just being a survival response to extreme events such as famine. This practice, and most probably other social practices articulating with it, formed an important component of local identity at EBA Koropi. The evidence for emerging

sociopolitical complexity, economic expansion and technological innovations in EBA Attica, combined with zooarchaeological evidence, suggest that cynophagy played a significant role in the negotiation of social relations between different groups of people on a local, regional or even supra-regional level.

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Chapter 12

Human–Animal Interactions during the Harappan Period in the Ghaggar Region of Northern India: Insights from Bhirrana

Arati Deshpande-Mukherjee, Amrita Sen and the late L. S. Rao

Since the early twentieth century numerous sites associated with different phases of the Harappan civilization have been discovered in the Ghaggar region of Northern India. Important excavated sites such as Kalibangan, Bhagwanpura, Banawali, Kunal, Rakhigarhi, Bhirrana and Farmana are characterized by their large size settlements, mud brick structures, ceramic assemblages, seals and association with human burials. Certain sites have evidence for early levels of occupation preceding the Mature Harappan period. Faunal assemblages recovered from many of the sites are being studied in recent years for understanding animal exploitation patterns during the Harappan period. Hence in this context the ongoing faunal research at Bhirrana is significant. The Harappan mound at Bhirrana is located on the northern outskirts of the modern village of Bhirrana overlooking the left bank of the dried up river Saraswati now known as the Ghaggar. The three seasons' excavations have yielded a continuous four-fold cultural sequence from the Hakra to the Mature Harappan period. Important finds such as ceramics, seals, copper objects, terracotta figurines, stone beads and chert blades were recovered along with large quantity of faunal remains. The ongoing archaeozoological investigations so far have revealed the exploitation of a wide spectrum of animals ranging from wild to domestic types. The presence of domestic cattle, sheep/goat and wild herbivores in the early levels indicate a mixed subsistence economy of hunting, herding and stock rearing. Attempts are being made to study the various ways in which different animals were used from the early occupation of the settlement to its Mature Harappan phase. These are hoped to provide suitable insights into the development of human–animal interactions in this region during the Harappan period.

Introduction

The Ghaggar region in northern India lies between the rivers Sutlej and the Yamuna encompassing the

modern states of Punjab, Haryana and Bikaner districts of Rajasthan (Fig. 12.1). In it lies the dry river bed of the Ghaggar, also referred to as the "Rigvedic Saraswati" in ancient literature having a width of 4–10 km and water only during the monsoon season. Its source lies in the Siwalik Hills of the Himalayas and it finally ends in the Rann of Kachchh. It is called the Hakra when it enters the Bhawalpur state in Pakistan. The Ghaggar region was first surveyed for archaeological remains by L. P. Tessitori during 1916–1917 followed in 1942 by Aurel Stein and later by others like Ghosh (1953), Suraj Bhan (1973), and Pande (1977).

These explorations have yielded more than 500 sites, many belonging to the Harappan civilization. Some like Kalibangan, Bhagwanpura, Banawali, Balu, Mitathal, Kunal, Rakhigarhi, Bhirrana and Farmana, have been excavated (Fig. 12.11). The sites are characterized by their large size settlements, mud brick structures, ceramic assemblages, seals, stone beads, terracotta figurines, *etc*. Of significance is the discovery of human burials at Kalibangan (Lal *et al*. 2003), Rakhigarhi (Nath 2001) and Farmana (Shinde *et al*. 2008).

A majority being Mature Harappan sites datable between 2500–1900 BCE, some like Kalibangan, Kunal, Bhirrana, Farmana, Girawad, have revealed early levels of occupation preceding the Mature Harappan period. These have provided us with fresh new data on the development of local Early Harappan cultures prior to the Harappan civilisation between the 4th and 3rd millennia BC.

Faunal studies have been carried out for some of the excavated sites like Kalibangan (Banerjee *et al*. 2003; Nath 1969), Bhagwanpura (Sharma 1993), Tarkanewala Dera (Deshpande-Mukherjee *et al*. 2008), Farmana (Shinde *et al*. 2008), Bhirrana (Deshpande-Mukherjee 2012; Sen 2012), Rakhigarhi (Uparatne 2012), Mithatal (Sharda *et al*. 2012); for a review of more recent faunal studies in Haryana refer to Joglekar *et al*. (2013). All these studies are indicating the Ghaggar region to be important for tracing ancient human animal interactions from the Early to the Mature Harappan period (Deshpande-Mukherjee 2010). In this context the ongoing faunal investigations at Bhirrana are significant. Hence, this paper attempts to trace these interactions by taking into account the faunal evidence from Bhirrana in particular.

Bhirrana is situated at a distance of 14 km northeast of the district headquarters Fatehbad in District Haryana (Fig. 12.1). The Harappan mound is located on the northern outskirts of the modern village after which it is named overlooking the left bank of the dry river Ghaggar. The mound measures 150 m from north to south and 190 m from east to west, rising to a height of about 5.50 m from the surrounding flat alluvial plain. The eastern part of the mound is relatively higher than the western part, as the latter was flattened for agricultural purpose in recent times. The maximum habitation deposit at the site was 4.20 m. Bhirrana was excavated for three seasons (2003–2006) by the late third author and his team from the Nagpur Excavation Branch of the Archaeological Survey of India. The site was divided into horizontal grids having standardized zones of A, X, Y, and Z with each trench measuring 10 × 10 m laid out in the north–south and east–west axis. About 70 trenches were excavated in the three excavation seasons.

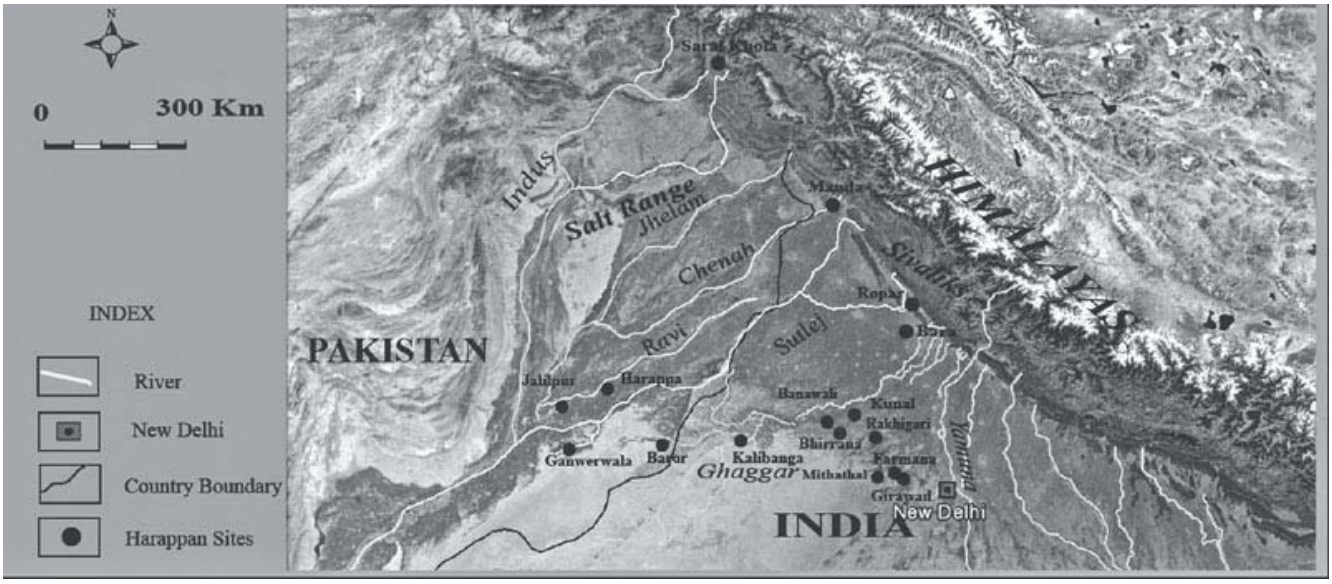

Fig. 12.1. Map showing Bhirrana and other important Harappan sites in the Ghaggar region.

At Bhirrana the C14 dates obtained from charcoal samples readily agree with the already accepted chronology of the Harappan civilization (2500–1900 BC) ranging from the Pre-Harappan to the Mature Harappan. Beside these, a few earlier dates were also obtained ranging from 6647 to 4353 BC (Rao *et al*. 2005). A continuous four-fold cultural sequence starting from the Hakra to the Mature Harappan period was proposed by the late L. S. Rao. Unfortunately due to his sudden demise in 2009 much of the cultural material from Bhirrana remains yet to be studied. Recently Dikshit and Mani (2012) have proposed a revised chronology based on the C14 dates from Bhirrana (Table 12.1). However for this analysis the cultural sequence proposed by the excavator has been adopted.

Table 12.1. Chronology for Bhirrana.

Earlier chronology (Rao et al. 2003–04)	*Chronology (Rao et al. 2004–05)*	*Revised chronology (Dikshit and Mani 2012)*	*Culture sequence based on C14 dates (Dikshit and Mani 2012)*
Pd.I (Early Harappan)	Pd.I A (Hakra ware culture)	Pd.I (Pre Harappan)	*ca.* 7500–6000 BCE
PdII (Transitional)	Pd.IB (Early Harappan culture)	Pd. II A (Early Harappan)	*ca.* 6000–4500 BCE
Pd.III (Mature Harappan)	Pd.II A (Early Mature Harappan culture)	Pd. II B (Late Early Harappan) transitional phase	*ca.* 4500–3000 BCE
	Pd.II B (Mature Harappan culture)	Pd.III (Mature Harappan	*ca.* 3000–1800 BCE

Period IA Hakra ware culture is the first cultural phase at Bhirrana preceding the Early Harappan culture. Its discovery with an independent stratigraphic existence below the Early Harappan deposit is significant (Rao 2006). This phase is primarily identified from the ceramics quite similar to those identified as Hakra ware by R. Mughal from sites in Cholistan (Mughal 1982, 1997). The discovery of

Hakra ware sites and its stratigraphic occurrence below the Kot Diji phase, *i.e*. the Early Harappan level at Jalilpur in Pakistan, firmly established the Hakra ware people as predecessors of the Early Harappans. At Bhirrana the ceramics comprise mud appliqué ware, incised ware, bichrome ware. This period was characterized by its subterranean dwelling pits which were cut into the deposit on the northern periphery of the mound. These pits occur in clusters are circular in shape. They are shallow in depth varying from 34 cm to 58 cm with a diameter of 230–340 cm, lacking any superimposing cultural deposit of the subsequent period. A total of nine pits numbering 1–9 were opened which have yielded animal bones, ceramics and objects like terracotta bangles, stone beads and crucibles of various sizes suggesting smelting of copper (Rao 2006). From their dimensions and contents these were probably used for different purposes such as dwelling, industrial, sacrificial and refuse.

Period IB Early Harappan culture. In this period a significant transformation in the structural activities and material culture were observed where the settlement expanded and the entire site came under occupation. It was probably not fortified as no defence fortification was revealed. The houses were built of mud bricks in the ratio of 3:2:1 and measured 45 × 30 × 15 cm, 42 × 28 × 14 cm and 39 × 36 × 13 cm. Early Harappan structures were exposed on the south central slope of the mound. Here a few circular pits were excavated. These have yielded terracotta figurines and from one pit a charred bovid skull was recovered. Besides this arrow heads, rings and bangles of copper, beads of carnelian, jasper, shell, bull figurines, chert blades, terracotta bangles were also found (Rao *et al*. 2006).

Period II A Early Mature Harappan. Is the transitional phase between the Early Harappan and the Mature Harappan period during which the settlement was reorganised and reoriented. It was surrounded by fortification. The concept of twin units of town planning, Citadel and Lower Town, came up wherein the citadel occupied the west-northwest part of the mound and the lower town east –south-east part. No complete house plans of this period have been exposed due to the overlying Mature Harappan structures.

Period II B The Mature Harappan period the excavations exposed Mature Harappan house complexes on the eastern, central and north western sides of the mound. Ceramics comprised painted ones which included geometric, floral and faunal motifs. A sherd of a storage jar depicting two stylized peacocks and pipal leaves was found. Also of interest is a fragment of thick sturdy red ware depicting an incised figure of a dancing girl closely resembling the famous bronze dancing girl from Mohenjo-daro.

Antiquities typical of the Mature Harappan period were recovered such as steatite seals, beads of semi-precious stone, shell and terracotta, animal figurines, bangles of faience, shell, copper bangles, chisels, rings, rods, *etc*. (Rao *et al*. 2005, 2006,). Four steatite seals were found of which one made in black steatite depicting a three headed animal, those of bull, unicorn, a deer and a horned deity are noteworthy. A good number of handmade stylised terracotta horns with a symbolic head painted in black were also found (Rao 2005).

Materials and methods

Large quantities of faunal material comprising bones, teeth, horn cores and a few molluscan shells were recovered from all the excavated trenches at Bhirrana using systematic recovery techniques such as dry sieving and hand collection. These were entrusted to the Archaeozoology Laboratory at Deccan College Post-Graduate and Research Institute, Pune for a detailed study. In this paper are discussed the

results of the faunal analysis carried out for trenches YF2, YG2 and ZE10/1 (pit DP 5). Besides this results from preliminary faunal investigations carried out earlier have also been taken into account (Amrita Sen 2012; Deshpande-Mukherjee 2012).

In trench YF2, bones recovered from a depth of 46–362 cm were studied from all the four cultural periods. Only the Mature Harappan period was identified in Trench YG2 from which bones were studied from a depth of 55–146 cm. In addition, faunal remains from the pit DP 5 in trench ZE10/1 from depths of 25–110 cm were also studied. The cultural deposit in this pit belonged to the Hakra period. The pit DP5 was located in trench ZE10/1 having a dimension of diameter 230 cm and a depth of 108 cm and did not have any overlying deposit. It comprised of loose soil deposit containing potsherds, animal bones, crucible fragments slag, terracotta bangles fragments, burnt clay lumps, sun-baked spherical clay lumps, sandstone sling balls, quartzite pounder/rubber sandstone pestle, and a terracotta net sinker (Rao 2006).

In the Archaeozoology Laboratory at Deccan College PGRI, Pune, prior to analysis the bone samples were subjected to cleaning under tap water to remove the soil adhering to it. All recording, weighing and identification was done following standard procedures of faunal analysis. Identification to the species level was attempted through comparison with the reference collection of modern animal skeletal elements housed within the Archaeozoology Laboratory. In addition, Schmid's *Atlas of Animal Bones* (Schmid 1972) and Hillson (1992) were also consulted for species identification. The following publications were referred to for more specific identification between cattle, buffalo and nilgai (Joglekar *et al*. 1994), sheep and goat (Prummel and Fisch 1986) and Pawankar and Thomas (2001) for distinguishing between black buck (*Antilope cervicapra*) and spotted deer (*Axis axis*). Unidentified bone fragments according to size were grouped as UF-L (large), M-(medium) and S-(Small). Both MNI and NISP estimation was attempted. Age estimation was calculated by studying teeth eruption pattern and epiphysal fusion in long bones (Silver 1963). Bone fragments were closely examined for all kinds of traces of human activity such as cut and chop marks, abrasion, polishing, along with breakage patterns, chemical alteration, weathering, burning activity, and discolouration. Bone measurements were taken following von den Driesch (1976; see Tables 12.6–12.8 for measurements of long bones of some wild herbivores).

The finds

A total of 13,580 animal skeletal elements from trench YF2 (N=1,039), YG2 (N=11,561) and ZE10/1DP5 (N=980) were examined. The assemblage shows a high rate of fragmentation but is fairly well preserved due to which many specimens could be identified. The following animal classes were identified: mammals (15), birds (1), reptiles (1), and fish (1) (Tables 12.2–12.5).

Table 12.2. NISP distribution of animal taxa in Trench YF2, YG2 and ZE10/1 (pit DP5).

Animal taxon	*Trench YF2 NISP*	*Trench YG2 NISP*	*Trench ZE10/1 (pit DP5) NISP*
DOMESTIC FAUNA			
Cattle *(Bos/bubalus)*	287	266	129
Cow/ox *(Bos indicus)*	162	162	15
Buffalo *(Bubalus bubalis)*	10	8	1
Goat/sheep *(Capra/Ovis)*	12	0	9
Goat *(Capra hircus)*	14	24	48
Sheep *(Ovis aries)*	8	3	
Small ruminant	32	119	26
Domestic pig (*Sus domesticus)*	–	2	–
WILD FAUNA		–	–
Gaur (*Bos gaurus)*	–	–	5
Black buck *(Antilope cervicapra)*	12	8	4
Nilgai *(Boselaphas tragocamelus)*	9	13	3
Deer Sambar *(Cervus unicolor).*	1	1	–
Spotted deer *(Axis axis)*	4	3	1
Chinkara *(Gazella bennetti)*	2	–	–
Barking deer *(Muntiacus muntjack)*	2	–	–
Four horned antelope (*Tetracerus quadricornis)*	–	3	–
Wild pig (*Sus scrofa)*	–	1	–
Leopard *(Panthera pardus)*	1	–	–
Fish	4	1	–
Bird (*Anser* sp.)	1	–	–
Turtle (*Lissemys punctata)*	–	–	2
Total identified	561	615	243
Total unidentified	478	10,946	737
Total	1039	11,561	980

Table 12.3. Cultural period wise NISP distribution of animal taxa in Trench YF2. UF: Unidentifiable, EH: Early Harappan, EMH: Early Mature Harappan, MH: Mature Harappan).

Species list	Pd. I A Hakra	Pd.I B EH	Pd.II A EMH	Pd.II MH	Total
Cattle *(Bos/bubalus)*	101	24	37	125	287
Cow/ox *(Bos indicus)*	26	7	22	107	162
Buffalo *(Bubalus bubalis)*	5	3	2	–	10
Goat/sheep *(Capra/Ovis)*	5	0	1	6	12
Goat *(Capra hircus)*	4	9	–	1	14
Sheep *(Ovis aries)*	2	0	1	5	8
Small ruminant	12	2	7	11	32
Black buck *(Antilope cervicapra)*	4	0	1	7	12
Nilgai *(Boselaphas tragocamelus)*	4	2	0	3	9
Spotted deer *(Axis axis)*	1	0	1	2	4
Chinkara *(Gazella bennetti)*	1	0	0	1	2
Barking deer *(Muntiacus muntjack)*	2	0	0	0	2
Deer Sambar *(Cervus unicolor)*	1	0	0	0	1
Leopard *(Panthera pardus)*	0	0	0	1	1
Fish	3	1	0	0	4
Bird	1	0	0	0	1
Total identified	172	48	72	269	561
UF	200	56	77	145	478
Total	372	104	149	414	1039

*Table 12.4. NISP distribution of animal taxon in Trench YG2 (after Sen 2012). B/B: Cattle (*Bos/bubalus*), BI: Cow/ox (*Bos indicus*), BB: Buffalo (*Bubalus bubalis*), Ch: Goat (*Capra hircus*), Oa: Sheep (*Ovis aries*), SR: Small ruminant, Ss: Wild pig (*Sus scrofa*), Tq: Four horned antelope (*Tetracerus quadricornis*), Sd: Domestic pig (*Sus domesticus*), Bt : Nilgai (*Boselaphas tragocamelus*), Cu: Sambar (*Cervus unicolor*), Aa: Spotted deer (*Axis axis*), Ac: Black buck (*Antilope cervicapra*).*

Depth in cm	B/B	BI	BB	Ch	Oa	SR	Ss	Tq	Sd	Bt	Cu	Aa	Ac	Fish
55–70	89	49	3	11	–	45	1	–	2	3	–	1	1	1
70–88	29	29	1	4	–	12	–	–	1	1	–	2	1	–
88–110	57	21	1	2	2	25	–	1	–	6	–	–	–	–
110–126	31	14	3	–	–	13	–	–	–	1	–	–	1	–
126–146	60	49	–	7	1	24	–	2	–	2	1	–	5	–
Total	266	162	8	24	3	119	1	3	3	13	1	3	8	1

*Table 12.5. NISP distribution of fauna in Trench ZE10/1 -pit DP5. B/B: Cattle (*Bos/bubalus*); BI: Cow/ox (*Bos indicus*), BB: Buffalo (*Bubalus bubalis*), C/O: Goat/sheep (*Capra/Ovis*), Ch: Goat (*Capra hircus*), Oa: Sheep*

*(*Ovis aries*), SR: Small ruminant; Bg: Gaur (*Bos gaurus*), Ac: Black buck (*Antilope cervicapra*), Bt: Nilgai (*Boselaphas tragocamelus*), Aa: Spotted deer (*Axis axis*), Lp: soft shelled turtle (*Lissemys punctata*), UF: unidentifiable*.

Depth in cm	*B/B*	*BI*	*BB*	*C/O*	*Ch*	*SR*	*Bg*	*Ac*	*Aa*	*Bt*	*Lp*	*UF*	*Total*
12–25	11	3	–	8	–	–	–	–	–	–	–	–	22
25–26	2	–	–	–	–	–	–	–	–	1	–	–	3
39–53	23	–	1	–	8	2	–	–	–	1	–	200	235
40–50	32	1	–	1	1	16	–	1	–	–	–	120	172
50–60	19	–	–	–	29		–		–	1	–	20	69
60–70	6	4	–	–	6	1	–	1	–	–	–	100	118
70–80	11	1	–	–		1	–		–	–	2	90	105
80–90	6	1	–	–	1	–	–	2	–	–	–	135	145
90–100	9	3	–	–	–	6	1	–	1	–	–	48	68
100–107	10	2	–	–	3	–	4	–	–	–	–	24	43
	129	15	1	9	48	26	5	4	1	3	2	737	980

Cattle

In the faunal assemblage, bones of domestic animals outnumber those of wild fauna. Of these cattle are the most abundant taxonomic group based on the counts of specimens to the genus level. As bones of both cow/ox and buffalo are fairly similar, their separation in the absence of specific skeletal features due to fragmentation was difficult to achieve. For this the criteria developed for separation of cattle, buffalo and nilgai by Joglekar *et al*. (1994) was used. However many of the bones had to be grouped under cattle as this separation was not possible. Among both cow/ox and buffalo, bones of the latter are very few. At Bhirrana the humped variety of the domestic cow/ox, *Bos indicus*, is identified from the presence of a bifid thoracic vertebra in the Mature Harappan period (Fig. 12.2). Its presence is also attested in the earliest level *i.e*. the Hakra period in pit DP5 in Trench ZE10. Among the various skeletal elements of *Bos indicus* found such as mandible, ribs, vertebrae, metatarsal, humerus, astragalus, *etc*., phalanges and isolated teeth are most common (Fig. 12.2). Many of the bones show charring, especially in Pit DP5. Cut-marks resulting from butchering activities for meat extraction were made with a sharp copper/bronze blade. A common practice was the chopping of the humerus in the distal shaft region.

The age profile of *Bos indicus* estimated from the wearing pattern of its teeth was reconstructed by referring to Grant (1982). It indicated the presence of young sub-adult and adult individuals. This indicates the use of young adults for obtaining meat and keeping of older bulls as draft animals, for ploughing and breeding.

Fig. 12.2. Top row, from left to right: bifid spine of thoracic vertebra, third phalange and third molar of Bos indicus. *Bottom row: mandibular symphysis and second phalanx of* Bubalus bubalis.

The height at withers of *Bos indicus* from the Hakra period was calculated for two individuals using the medial length of astragalus measurements (Zalkin 1970) which was 111.08 cm and 114.5 cm. These fall within the cattle height range of 110–115 cm calculated for some of the Harappan sites in Haryana such as Farmana, Girawad and Mitathal (Joglekar 2013) and Gujarat (Goyal 2011).

Bones of domestic buffalo although few were identified in all the periods and had also contributed to the food economy. These comprised fragments from mandibular symphyses horn cores, distal humeri, first, second phalanges and calcanei. Charring was observed in some of these bones (Fig. 12.2).

Small ruminants

In the assemblage due to fragmentation a good proportion of bone fragments of goat/antelope/deer sized animals which could not be identified to species level were grouped as small ruminants. These mostly comprised fragmented long bone shafts.

Goat/sheep

Similar to cattle, bones of domestic goat (*Capra hircus)* and sheep (*Ovis aries)* also being fairly similar, were difficult to separate in the absence of skeletal markers. Hence these were grouped as *Capra*/*Ovis*.

For further specific identification of both these animals the criteria given by Boessneck (1969), Prummel and Frich (1986), Zeder and Lapham (2010) was consulted. *Capra hircus* was identified by fragments from its maxilla, mandible, teeth, astragalus, scapula, phalanges, metapodials and was found in all the periods in trench YF2 (Fig. 12.3). The height at withers calculated from measurements (after Altuna 1979) on one astragalus of *Capra hircus* from the Hakra period in trench YF2 was 56.13 cm. In the Hakra level in trench YF2 and Pit DP5 unfused bones of metatarsal, metacarpal, tibia, scapula and pelvis of a young goat were found. As compared to goats, bones of sheep (*Ovis aries)* are few comprising mandible, mandibular condyle, scapula, radius, first phalanx and metatarsal (Fig. 12.3). Some of the bones of both sheep and goat show charring and unfused condition indicating young individuals.

Pigs

Both domestic and wild variety were identified in trench YG2 (Sen 2012). The former by two mandible fragments, one without teeth and the other with two molars and one premolar. While the wild form *Sus scrofa* was identified by one complete unfused phalanx (Sen 2012). Charred bones of wild pigs, such as atlas vertebra, unfused proximal radius, proximal ulna, mandible condyle and a complete astragalus were also found in other trenches ZD11/2, A2/1, B2/IV and YF3/1 (Deshpande-Mukherjee 2012).

Fig. 12.3. Top row: unfused metacarpal (Capra hircus), *mandible* (Capra hircus), *mandible* (Ovis aries). *Bottom row: scapula and first phalanx of Capra hircus, metatarsal* (Ovis aries).

Wild fauna

A variety of wild herbivores such as the gaur/bison (*Bos gaurus*), nilgai (*Boselaphas tragocamelus)*, sambar (*Cervus unicolor*), spotted deer (*Axis axis*), blackbuck (*Antilope cervicapra*), barking deer (*Muntiacus muntjac*), Chinkara (*Gazella bennetti*) and four horned antelope (*Tetracerus quadricornis*) have been identified (Fig. 12.5; Tables 12.6–12.8). However, bones of all these animals are very few, mostly making isolated appearances such as a scapula fragment with glenoid cavity of chinkara in YF2 or from the Hakra level a pelvic fragment of deer. In comparison the nilgai and blackbuck are commonly present in all the four periods in trench YF2 (Fig. 12.4; Table 12.3). These are represented by parts of mandible, humerus, tibia, metacarpal, radius, and first and second phalanges. Both these animals in herds are found to inhabit open plains with scrub and cultivated areas. It is quite likely they had lived in the vicinity of the settlement. Hence could be commonly hunted. Whereas the four horned antelope (*Tetracerus quadricornis*) and barking deer (*Muntiacus muntjac*) inhabit hilly areas and were probably less accessible. Three charred bones of the former, two of tibia and one from the proximal part of metatarsal were found in trench YG2 (Tables 12.2 and 12.4) (Sen 2012). While only two femur fragments of the barking deer were found in trench YF2 (Fig. 12.5). Similar might have been the case with the large wild bovid *Bos gaurus* which has so far been identified only in the Hakra period by a large mandibular symphyses and horn core in Pit DP5 in trench ZE10 and a charred proximal metatarsal in trench ZD10 (Deshpande-Mukherjee 2012). This shy timid animal basically an inhabitant of hilly forested areas, lives in small herds. Its large size and acute smell makes it difficult to hunt them. Its nearest probable source was the foothills of the Himalayas.

Fig. 12.4. Bones of Boselaphas tragocamelus: *horncore, distal metatarsal with cut mark, proximal metacarpal and first phalanx.*

Fig. 12.5. Top row, left to right: distal humerus (Antilope cervicapra), *distal tibia and humerus* (Axis axis), *proximal femur* (Muntiacus muntjac). *Bottom row: scapula* (Gazella bennetti) *and a part of the right mandibular symphysis* (Panthera pardus).

Carnivores

There is negligible reporting of carnivore bones except for a part of a right mandibular symphysis belonging to *Panthera pardus* from the Mature Harappan period in trench YF2. This is a significant finding as this carnivore has not been reported from any other site in this region so far (Fig. 12.5). Besides these, scarce occurrence of small mammals is also observed except for a complete second phalanx of hare (*Lepus nigricollis*) in trench B2/1 at depth of 0.65 cm (Deshpande-Mukherjee 2012).

Birds

Bird bones are almost scarce in the assemblage except for a broken long bone shaft of duck (*Anser* sp.) from trench YF2 at a depth of 340-355 cm. However five long bone shafts, two of which are of *Gallus domesticus* size were identified in trench B2/1 and B3/1 (Deshpande-Mukherjee 2012).

Fish

Aquatic fauna is represented by a few vertebrae belonging to freshwater fish which are yet to be

identified. These are very small in size and charred. A shell fragment of freshwater turtle *Lissemys puncatata* was also found in the Hakra levels in trench ZE10/1 (pit DP5).

*Table 12.6. Humerus (HU) and radius (RA) measurements of Ac (*Antilope cervicapra*), Aa (*Axis axis*) and Bt (*Boselaphus tragocamelus*), PD: period, BN: Bone, BP: proximal, SD, BD.*

Trench	No.	PD	BN	Portion	Species	BP mm.	SD mm.	BD mm.	Comments
YF2	–	IIB	Hu	P	Ac		16.10	28.53	
YF2	158	IIA	Hu	D	Ac	–	13.20	26.8	Just fused
YF2	181	IIB	Hu	D	Ac	–	–	30.84	
YF2	–	IIB	Hu	D	Ac	–	–	24.33	
YF2	182	IIB	Hu	D	Ac	–	–	26.83	
YF2	167	IA	Hu	D	Ac	–	15.09	28.57	
YF2	173	IA	Hu	D	Ac	–	–	21.98	Just fused
YG2	602	IIB	RA	D	Bt	–	–	64.31	
YG2	580	IIB	Hu	D	Aa	–	–	30.03	
YF2	–	IIB	RA	P	Ac	25.55	–	–	
YF2	183	IIB	RA	P	Ac	24.40	–	–	

*Table 12.7. Metacarpal (MC) and Metatarsal (MT) measurements of Gz (*Gazella bennetti*), Bt (*Boselaphus tragocamelus*), Ac (*Antilope cervicapra*), Cu (*Cervus unicolor*) and Tq (*Tetracerus quadricornis*).*

Trench	No.	PD	BN	Portion	Species	BP mm.	SD mm	BD mm
YF2	154	IIB	MT	D	Gz	–	13.92	18.94
YF2	184	IIB	MT	D	Bt	–	28.96	50.96
YF2	179	IIA	MC	D	Bt	–	–	43.83
YF2		IA	MC	P	Bt	48.54	–	–
YG2	520	IIB	MC	P	Ac	21.00	13.13	–
YG2	630	IIB	MC	D	Cu	–	–	49.6
YG2	633	IIB	MT	P	Tq	17.25	10.25	–

*Table 12.8. Femur and tibia measurements of Aa (*Axis axis*), Bt (*Boselaphus tragocamelus*)* and Tq *(*Tetracerus quadricornis*).*

Trench	No	Pd	Bn	Port.	Species	Bp mm	Sd mm	Bd mm
YG2		IIB	FE	D	Aa	–	–	34.00
YG2	572	IIB	TI	P	BT	46.03	–	–
YG2	540	IIB	TI	D	TQ	–	12.34	22.03
YG2	553	IIB	TI	D	TQ	–	–	22.00

Discussion

The ongoing faunal study at Bhirrana has revealed the wide spectrum of animals that were exploited by the site inhabitants during the Harappan period. This has helped trace the human animal interactions from the earliest to the Mature Harappan period. Animal remains along with terracotta animal figurines, animal depictions on pottery, seals strongly indicate the important role of animals in the economy of the Harappans in the Ghaggar region.

Large scale exploitation of both domestic and wild animal resources is visible largely dominated by that of cattle in all the periods. No major shifts in animal exploitation patterns have been observed over time so far.

A majority of the bone assemblage studied has mainly resulted from subsistence related activities where these had been largely exploited for food purposes. The large quantities of cattle bones strongly suggests that domestic cattle had played a dominant role in the food economy of the site inhabitants as well as in agricultural activities. Besides providing meat, dairy products, dung, these were also used as traction and in agricultural activities. Cattle rearing and herding was commonly carried out at the settlement since its early occupation. Presence of Zebu, *i.e*. the humped variety of *Bos indicus* from the early levels reveals its occurrence as well as significant association with the site inhabitants. Even in present times it is used in northern India in ploughing and traction.

Use of the domestic buffalo even though limited is attested in all the periods at Bhirrana. A similar aspect has been observed at other sites such as Farmana, Girawad and Mitathal (Joglekar 2013). Even in present times in India parallel herding of both cows and buffalos is practised for obtaining similar products like milk, dung, *etc*. Similarly small herds of goats and sheep were kept alongside that of cattle which had also contributed to the food economy. Besides these, evidence for the use of domestic pigs for dietary purposes along with hunting of wild pig in small proportion by the site inhabitants is attested so far only in the Mature Harappan period. A major dependence on domestic fauna at Bhirrana in a way reflects the agro-pastoral and sedentary nature of the settlement since its early occupation. A feature still observed in many of the modern agricultural settlements in India.

The identification of wild herbivores like the gaur, nilgai, blackbuck, chital, barking deer and chinkara in the Hakra and Early Harappan periods at Bhirrana indicates that hunting was carried out since the early occupation of the site. These had supplemented the food economy of the Bhirrana inhabitants. Most commonly hunted were the nilgai and black buck. In present times the nilgai also called as the blue bull roam in herds destroying crops in parts of Rajasthan, Gujarat and Haryana. There was preference for younger animals as seen from the deciduous teeth and unfused long bones of both these animals. The isolated occurrence of select skeletal parts of spotted deer, barking deer, chinkara, suggests that post hunting probably partial carcases were brought to the site for meat processing.

The presence of a variety of wild fauna at Bhirrana reveals the faunal diversity in existence then in the Ghaggar region. By taking into consideration the present day habitats of the wild fauna identified, the site inhabitants had exploited animals from varied ecological habitats. These ranged from thickly wooded forest, forested hill slopes to open, flat and undulating landscapes with shrubs, grasslands, swamps, *etc*. Animals like the buffalo, pigs, gaur, require a wet humid climate hence their presence indicates that such conditions were prevalent during the Harappan period at Bhirrana.

There is also evidence for small scale exploitation of aquatic resources like fish and turtles by the

site inhabitants which is further supported by the presence of copper fish hooks. Their presence particularly in the Hakra period indicates the Ghaggar to have supported ample aquatic resources during this period. Interestingly, so far there is scarce evidence for the occurrence of riverine molluscs or even its exploitation.

At Bhirrana certain animals besides their dietary role were attributed considerable socio-religious significance in particular were cattle. The presence of terracotta bull figurines and stylised terracotta animal heads with horns from the Mature Harappan period reflect this aspect. The later are handmade with a symbolic head painted in black. The head or snout portion is represented by a rectangular projection with faint concave sides at the bottom upon which along the marginal sides of the broad forehead rise incurving horns with rectangular cross-section (Rao 2005). Besides these, presence of a charred bovid skull in pit DP7 and 8 of the Hakra period does suggest a ritualistic aspect. However, this aspect needs more investigation. While depiction of peacock and antelope on pottery was not a mere artistic expression but reflects the inhabitants relationship with this animal. It is to be noted that antelope was a commonly hunted animal.

To conclude the study so far suggests that Bhirrana had witnessed a strong cattle based economy supplemented with sheep goat herding, pig husbandry and hunting of wild herbivores. This along with agricultural activities had contributed to its growth into a major Mature Harappan settlement in the Ghaggar region during the Harappan civilisation.

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Chapter 13

Bringing to Light the Animal Bone Assemblages from the Ancient Burials of Armenia

Nina Manaseryan

Animal bones retrieved from burial contexts represent one of the least studied aspects in the archaeozoology of Armenia. The scientific collections of the Institute of Zoology of the NAS RA house more than 20 such burial assemblages that were uncovered over the years covering a broad chronological spectrum within the frame of the Bronze and Iron Ages (ca. 3500–3600 BC) and the Classical period (600 BC–301 AD). These assemblages comprise over 14,000 specimens of vertebrate skeletal remains, some of which belong to complete or nearly complete sets of skeletons, and in some cases only the skulls of cattle, sheep, horses, pigs and dogs. In this paper I present selected examples of this impressive corpus, referring also to tombs which were discovered within the drained part of Lake Sevan, central Armenia. This study brings to light varied burial practices related to animal interments through the ages. There is tremendous potential in conducting further systematic and comprehensive analysis of the material to benefit research on religious and ritual practices and the role of animals in the symbolic world of the inhabitants of the Bronze and Iron Ages and the Classical Period in the southern Caucasus.

Introduction

Animal interment within burial contexts is a poorly studied aspect of archaeozoological research in Armenia, and until now the wealth of discoveries in this arena has not been brought forth to the attention of the scientific community. The burial assemblages found within the country mainly in the chronological frame of the Bronze and Iron Ages and the Classical Period have yielded an exceptionally rich, diverse and uniquely-preserved material culture through which the connecting thread is their reflection of the realities and funerary traditions of the social elites of the time. From an archaeozoological perspective, some of the most commonly observed patterns uncovered through excavations of the burial contexts include findings of complete or partial skeletal remains of the main livestock species of the region comprising cattle, sheep and horse, as well as of the isolated skulls of pigs and dogs. In some cases, isolated skeletal elements including limb bones, mandibles, vertebra and

ribs belonging to these same species were found on altars, either placed nearby and/or entered within a ceramic pot. Chambers in the well-known burial mounds unearthed at cemeteries such as those of Lchashen (Lake Sevan), Lori Berd and Nerkin Naver (Fig. 13.1) yielded skulls in association with the limb bones of cattle and horse (Fig. 13.2).

Fig. 13.1. Map of Armenia showing the geographic distribution of sites mentioned in the text.

Fig. 13.2. Limb bones of bulls from Bronze Age burials NN96, 108, 116, 134 of the Lchashen cemetery.

Taxonomic and anatomical patterns

A clear taxonomic preference is revealed at the burials of the Bronze Age Lchashen cemetery (central Armenia), where more than 50% of the faunal assemblage is attributed to sheep. Cattle remains predominated in the faunal assemblages of the Early Iron Age period burials from the citadel of Horom in north-western Armenia. At the Bronze-Iron Age cemetery of Lori Berd in northernmost Armenia horse skeletal remains comprise the majority of the finds. In order to understand the meaning of such patterning and their relevance in the symbolic world of ancient social élites it is necessary to carry out systematic comparative analysis of both burial and domestic faunal assemblages from the above mentioned time periods. In terms of selection for particular types of skeletal elements, a recurring pattern at Lchashen burial mounds is the fact of finding together the skulls of sheep and the left-sided thigh bones of cattle, as a rule represented by two and four elements of each. The presence of the bones of an animal's left side next to the dead, invoking a belife that one side of the animal is edible and the other unclean (Mnatsakanyan 1961), may represent a burial custom which was wide-spread throughout the Levant and adjacent regions in antiquity. Burials at the Classical Period Shirakavan cemetery yielded skulls of dogs placed near the heads of human interments (N13, first–third centuries BC, Fig. 13.3), and the jaws of sheep and the limb bones of both sheep and cattle, which were found near the legs of the buried individuals in Bronze Age tombs at the same cemetery.

Burial remains of wild animals

The skeletal remains of wild animals, which likely represent remnants of hunting trophies and occasionally were used for cultic practices, are less frequently found in the ancient tomb structures. Different species of wild ungulates make up a significant proportion of the finds. These include red deer (*Cervus elaphus maral O.*), roe deer (*Capreolus capreolus L.*), gazelle (*Gazella subgutturosa Gul.*), and mouflon (*Ovis orientalis Gmelin.*). Species of predators include fox (*Vulpes vulpes L.*), stone marten (*Martes foina Erxl.*), marbled polecat (*Vormela peregusna G.*), the European badger (*Meles meles L.*), and otter (*Lutra lutra L.*). The skull and mandible of a wild bull – *Bos primigenius Boj* were uncovered within an Iron Age burial at the site of Shamiram (beginning of the first millennium BC). Rarely, the remains of lagomorphs such as the European hare (*Lepus europaeus Pallas*) and of insectivores such as the hedgehog (*Erinaceus europaeus*) were uncovered. Of the wild species as a whole, the remains of different species of deer, fox and badger comprise the most commonly found taxa. The Bronze Age cemetery of Verin Naver represents a stark exception to the above-described pattern as 16 different species of wild mammals were recovered from the burials.

Fig. 13.3. Dog skulls from the Classical period burial N13 at Shirakavan.

Particular attention is drawn to a complete skeleton of a hedgehog, which was discovered in an Iron Age burial (N5) at Gogaran cemetery in north-west Armenia (Fig. 13.4). Similar finds have often been attributed to incidental occurrences due to intrusion of the animals into the archaeological contexts, for example, through denning activities or accidental fall. Nonetheless, at the Gogaran burial,

the finding of the hedgehog skeleton within a complex underground structure (Fig. 13.5) and in association with additional artifacts indicating the performance of a burial rite suggest otherwise. The Gogaran cemetery contains megalithic monuments, which, together with the remains of a fire place, pieces of obsidian and bored canine teeth of a wild boar found inside the same tomb, suggest that an act for protection of the dead took place at the site. The Early Iron Age period burials from the citadel of Horom present another case where remains of a hedgehog were found together with jewelry, totemic items, and additional remains of small predators including polecat and marten in burial N 44 (Badalyan and Agekyan 1993).

It is known that the hedgehog was considered a sacred animal among different communities of the ancient world such as the Egyptians, Romans and ancient Chinese (Muller 2007; Rack 1993). Association of the hedgehog with the Egyptian solar deity Ra may indicate an ancient belief in its spiritual significance as protector in the afterlife and a symbol of rebirth. During Old Kingdom Egypt, in the third millennium BC, these animals were frequently entered in tombs as part of the burial ceremony. During different times in antiquity, the symbol of a hedgehog was also adopted by ruling elites and found, for example, as figurines in Sarmatian burials in the classical period (Shtein 1968), and engraved on a golden buckle which was described among the Siberian collections of Peter the Great (Rudenko 1962).

Burial practices related to animal remains

Evidence for funeral rites related to animal worship can be found in discoveries of a number of unique practices involving the separate burial of the animal. Two notable examples include: (1) a Bronze Age burial of a bull associated with ritual artifacts among the burial mounds of Lake Sevan (Mrtbti Dzor cemetery) and (2) a burial of a ram at the Iron Age cemetery of Tsamakaberd. Of special interest is a dog burial attached to tomb N42 at the Iron Age cemetery of Bover I near the village of Teghut in northeastern Armenia (Fig. 13.6). The burial may have been associated with the worship of the dog-like Armenian deity (i.e. a cynocephalus) Aralez. The burial context conjures the ancient belief that Aralez descended onto battlefields to resurrect the braved deceased warriors by licking their wounds. Dogs may also have been buried along with their owners to guard them in the afterlife reflecting the function of dogs in everyday life and their significance in ancient ideological and cultic worldviews.

Beginning in the Middle Bronze Age and continuing through to the Classical period, horses are found in burial contexts across Armenia in burial mounds and cemeteries such as those at Lori Berd, Lchashen and Shirakavan. Analysis of these assemblages of horse remains show that they belonged mainly to medium-sized and tall animals, respectively comprising 45.2% and 34% of the entire set of remains currently at our disposal. Variation in coat color as detected from surface examination of the bones is substantial, including reddish-brown tints such as Chestnut Sabino at Lchashen (fifteenth–thirteenth centuries BC); Bay at Lori-Berd (eighteenth–twentieth centuries BC), and Chestnut at Shirakavan (eighth–ninth centuries BC). Based on the recent study by Ludwig *et al*. (2009) on the genetic history of coat color variation in horses, the substantial variation observed in the first–second millennia BC. in Armenia indicates the rate of impact of human selection on the horse phenotype since its domestication in the third millennium.

Sacrificial horse offerings in Armenia are traced back to the Middle Bronze Age. Findings of complete and partial skeletons entered into burials which likely belonged to their owners, have been

discovered in many burial mounds such as those of Nerkin, Verin Naver and Lori Berd. A recently discovered burial of a horse with a bronze ring attached to its mandible was found at the Iron Age burial N72 of Aghavnatun graveyard, western Armenia (Gasparyan *et al*. 2013). Measurements obtained from the well-preserved skeletal elements (humeral bone: 315 mm, forearm: 350 mm, metacarpal: 235 mm and metatarsal: 284 mm) indicate that it was an adult animal with body proportions placing it in the category of "Taller Horses" (Fig. 13.7). The horse was likely either a war or a gala horse used by nobility. According to the Greek historian Xenophon (fifth century BC), horses in ancient Armenia were sacrificed to the Sun deity, considered the god of speed and associated with the horse as an especially fast animal. It is also known that the custom of horse sacrifice was widely practiced in both royal funerals and commemoration days celebrated a year after death.

Fig. 13.4. Skeleton of a hedgehog discovered in an Iron Age burial N5 at Gogaran.

Fig. 13.5. Main view of the Iron Age burial N5 at Gogaran.

Fig. 13.6. Dog burial attached to the tomb N42 at Bover I cemetery.

Fig. 13.7. Bones from a horse skeleton from Iron Age burial N72 at Aghavnatun.

Comprehensive meta-analysis of the archaeozoological material from the burial contexts of Armenia in prehistory and historical periods, many of which evince a unique state of preservation, holds tremendous potential for collecting rich information on the lifeways and symbolic and ritual world of social élites through time, as well as on patterns of variation in the phenotypes of domestic animals along both geographic and chronological gradients.

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Chapter 14

"Making the Cut": Changes in Butchering Technology and Efficiency Patterns from the Chalcolithic to Modern Arab Occupations at Tell Halif, Israel

Haskel Greenfield and Annie Brown

Recent research has suggested that the transition from stone to metal technology occurred between the end of the Early Bronze Age and beginning of the Late Bronze Age. Very few archaeological sites with large and well-dated zooarchaeological assemblages transcend this moment in time. Tell Halif is a prominent settlement located in the Judean hills overlooking the foothills and the coastal plain of Philistia in Israel. The site has been inhabited since the Chalcolithic and served as an important economic centre since the beginning of the Early Bronze Age. Faunal remains with evidence of butchering were recovered by the Lahav Archaeological Research Project (1976–1987). This paper will describe and interpret the changes in butchering patterns and its relationship to the introduction of bronze metallurgy from the Chalcolithic, through the Bronze Age, and later periods at Tell Halif. Several results are evident from this study. First, metal butchering marks initially appear, but in very small frequencies, during the Early Bronze III. Second, the use of metal tools only becomes dramatic with the advent of the Late Bronze Age. By the end of the Late Bronze age, stone tools were mostly replaced by metal tools for butchering. Third, stone tools continue to be used into modern times at the site. Fourth, the transition from stone to metal technology resulted in changes in efficiency of the butchering process (fewer marks/bone). The analysis of butchering technology and butchering process allows for a unique perspective on the economic and political changes occurring between the Early Bronze and later periods in the Levant.

Introduction

In the Neolithic and Chalcolithic, copper and other metals are shaped for the production of various display items (*e.g.* ornaments, mace heads, axes, *etc*.) (Levy 1995a, 1995b, 2007; Levy and Shalev 1989). With the advent of the Bronze Age, metal tools, specifically made of bronze, become

widespread (Avilova 2009; La Niece *et al*. 2007; Yener 2000). Bronze is an alloy created by the mixing copper and tin to produce a more malleable and far stronger material than copper. The introduction of bronze metallurgy opened up new potential domains for the use of early metal technologies (Moorey 1988; Muhly 1988). However, it is very difficult to assess the relative importance of various technologies in the archaeological record. Metal objects will be for the most part recycled when worn or damaged. While most research on the origins of metallurgy has been conducted on metal artefacts, this is probably a very biased sample. It is likely that very few were lost, ritually deposited or hidden and forgotten to be found by archaeologists.

Over the years, a number of studies have demonstrated that it is possible to identify the nature of the raw material of a tool from the groove left on bones (*e.g*. beginning with Binford 1981; Shipman 1981). As a result, it is now possible to distinguish stone from metal tool marks and use them as the basis for quantifying their relative importance over time and for various functions (Greenfield 1999). Faunal remains are found in large numbers on most sites and are generally well-preserved throughout the Near East. Many of these bones have microscopic grooves that are the result of ancient butchering activities. These grooves can be used to identify the transition from a stone- to metal-based technology in the local butchering industry. Faunal remains allow us to examine aspects of butchering that would otherwise be difficult to reconstruct in the absence of the butchering tools themselves. Therefore, it becomes possible to identify the different raw materials used to make butchering tools, determine the relative efficiency of the different raw material used in butchering, and discuss the wider issue of how and why metallurgy is adopted and its spread through a region.

This study is designed to test the idea that metal tools were adopted for utilitarian or mundane activities, such as animal butchering, only after a tin-bronze metallurgy was fully developed during the later EBA. It is commonly assumed that stone was discarded when tin-bronze metal tools were introduced in the Bronze Age (Ben-Tor 1992; Mazar 1990). This is supported by the evidence that stone tools were dramatically declining during the Chalcolithic, Bronze and Iron Ages (Rosen 1997). However, this proposition has never been systematically tested for a multi-period site in southern Israel. This paper presents the results of an investigation into the evolution of metal as a tool for butchering animals at Tell Halif, Israel.

Site description

The Lahav Archaeological Research Project was directed by Joe Seger, and extensively excavated between 1976 and 1987 (Seger 1983; Seger *et al*. 1990) (Fig. 14.1). Tell Halif is a prominent ancient settlement in southern Israel nestled amidst the Shephelah (rolling hills) of Judea towards its southern end. To the west are the plains of Philistia, to the south is the Negev desert, and to the east are the mountains of Judea. The site has easy access to water sources and is surrounded by rich agricultural lands. Tell Halif is located in the midst of a variety of ecosystems and therefore has access to a great diversity of flora and fauna. This natural abundance allowed Tell Halif to prosper.

Historically, Tell Halif was located strategically on a major trading route from Egypt and the Mediterranean Sea to Jerusalem. It has been occupied since the end of the Chalcolithic period (*ca*. 3500 BCE) and has served as a regional economic centre since the Early Bronze Age (EB). The archaeological record shows that throughout the Bronze Age, Tell Halif went through several stages of development and destruction. By the Early Bronze (EB) I (*ca*. 3,600–3,100 BCE), Tell Halif was a

large, well-developed village with extensive trade contacts. The settlement grew into a town during the EB II (*ca*. 3,100–2,900 BCE) and was surrounded by fortifications. At the end of the EB III (*ca*. 2,500 BCE), the site was abandoned and not reoccupied until the beginning of the Late Bronze (LB – *ca*. 1,500 BCE). The Middle Bronze (MB) Age is missing at the site, except for some tombs. In the LB, it became a major centre once again during the Iron Age. This reoccupation marked the beginning of Tell Halif's most prosperous period. Subsequently, the site went through several more stages of destruction and reoccupation until modern times.

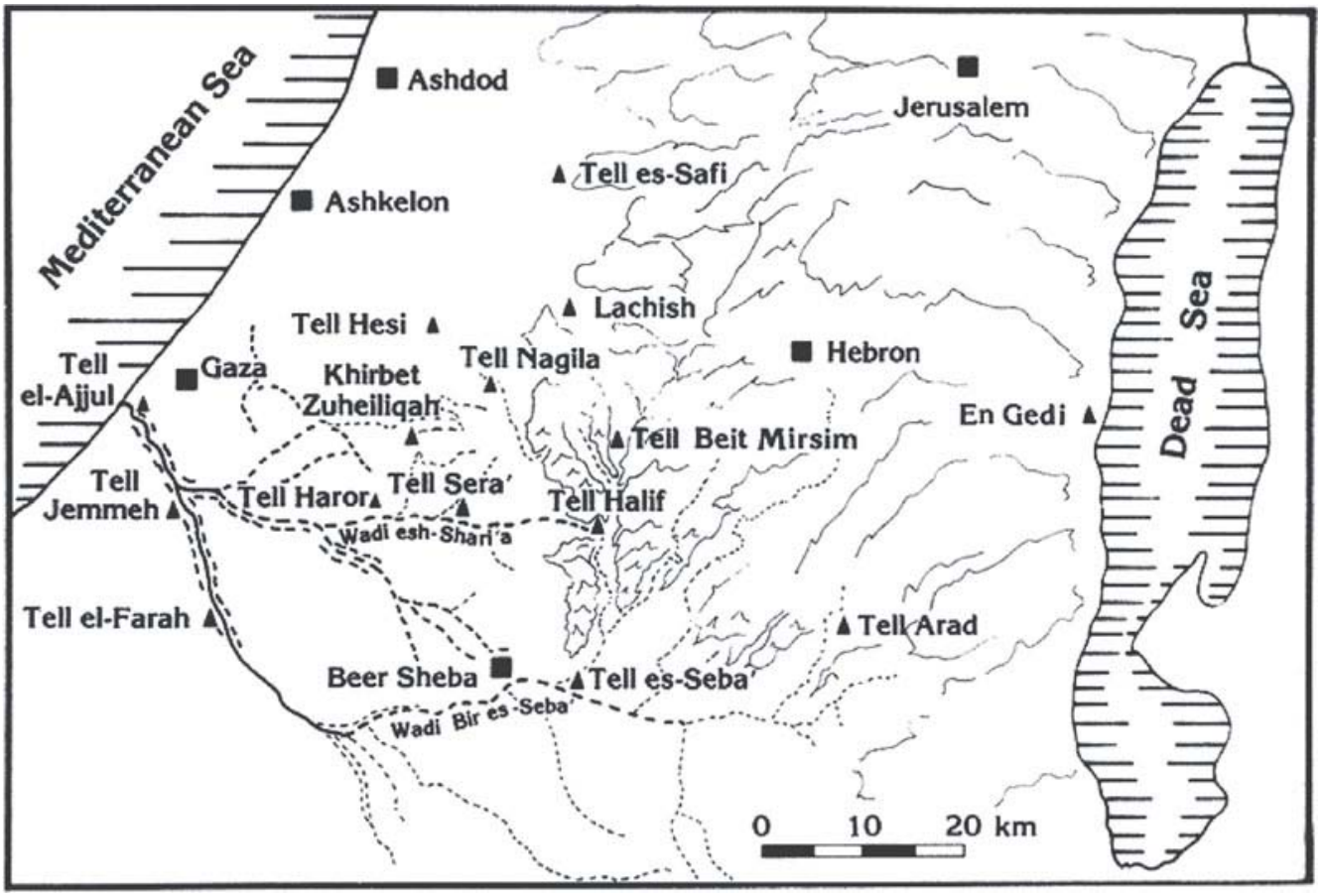

Fig. 14.1. Map showing location of Tell Halif and other sites in the region.

Hypothesis

Since the goals of this project encompass determining changes in both the butchering process and the butchering implements themselves, the following two hypotheses will be tested: (1) If there is a change in groove morphology over time, then this may reflect the introduction of metallurgy into the butchering process; (2) If the number of butchering marks per bone decreases as metal replaces stone, then the introduction of metallurgy represents an increase in efficiency.

Sample size

Over 30,000 fragments of bones were collected at the site from all periods and were analyzed by Melinda Zeder (Seger *et al*. 1990). Subsequently, HG identified a significant number of faunal remains with evidence of butchering in the assemblage (n>3,000 fragments). Of these, over half were selected for detailed analysis based on the periods of interest. Since the focus of the research was on the

transition to metallurgy during the Bronze Age, all remains from the Chalcolithic and Bronze Age were fully analysed. A sample of butchered remains from each of the subsequent periods was also analysed in order to see if there was any post-Bronze Age use of metal tools for butchering (Table 14.1). In a few other assemblages, such usage had been detected (Greenfield 2013). This yielded a total sample size of 1,563, of which 1,523 specimens are from chronologically secure deposits. The assemblage crosscuts the larger chronological sequence of the site. The vast majority of specimens are from the Early and Late Bronze Age. This accounts for 86% of the assemblage, which are the periods of interest for this study. Almost 6% is from the Iron Age, followed by the Persian (1%), Hellenistic (0.2%), Late Roman/Byzantine (3.9%), and modern Arab (2.4%). Forty specimens could not be assigned to a period (2.5%).

The frequencies are not the same for all sub-periods (Table 14.2). This is especially relevant for the Bronze and Iron Ages. All of the Chalcolithic remains are from the Late Chalcolithic. The Early Bronze remains are from EB I (n=17) and III (n=593). The Late Bronze Age remains are from I (n=278) and II (n=426). The Iron Age sample is divided between I (n=22) and II (n=68).

Table 14.1. Frequency distribution of all butchered bones by period, excluding unknown periods (NISP), included in this study.

Period	*No. specimens*	*%*
Chalcolithic	3	0.20
Early Bronze	610	40.05
Late Bronze	704	46.22
Iron	90	5.91
Persian	17	1.12
Hellenistic	3	0.20
Late Roman/Byzantine	59	3.87
Modern Arab	37	2.43
Total	1523	100.00

Table 14.2. Frequency distribution of butchered bones by period and sub periods, excluding unknowns (NISP).

Periods	*No. specimens*	*%*
Chalcolithic	3	0.20
Late	3	0.20
Early Bronze	610	40.05
I	17	1.12
III	593	38.94
Late Bronze	704	46.22
I	278	18.25
II	426	27.97
Iron	90	5.91
I	22	1.44
II	68	4.46
Persian	17	1.12
Hellenistic	3	0.20
Late Roman/Byzantine	59	3.87
Modern Arab	37	2.43
Grand Total	1523	100.00

There were some constraints on which specimens were included in the analysed assemblage. The goal of the larger study was to monitor the introduction of metal for butchering purposes. Based on experimental research, slicing cut/butchering marks are easiest to identify whether they were made by stone or metal butchering tools. This stands in contrast to chop marks which often destroy the diagnostic features that allow researchers to identify whether they were made by stone or metal axes. Other types of butchering marks were also noted (*e.g.* saw), but were very rare.

The largest group of butchering marks that were not systematically recorded were chopping marks made by axes or bashing marks made by hammer stones. When clearly identifiable as chopping or bashing, they were noted. However, in most cases, chops (for dismemberment) and bashes (to break open bone) did not leave clear and consistent evidence of their nature, possibly because of the material from which they were made (*e.g*. stone). Where chops and bashes were visible within the butchered assemblage (identified on the basis of slicing marks), they were recorded.

In this paper, we will describe the distribution of butchered remains with slicing marks. The large sample of butchered remains from Tell Halif provides an opportunity to investigate the shift in the nature of butchering technology over time. The analysis will describe the remains from each of the major prehistoric and historic periods at the site: Chalcolithic, Early Bronze, Late Bronze, Iron Ages, and later periods. While the sample size is different between periods, this cannot be corrected for since the analysis includes all of the specimens in the assemblage. The later periods (post-Iron Age) were analysed to confirm the nature of changes first visible in the Late Bronze Age at the site.

Identifying raw material based on the morphology of butcher slicing marks

In order to distinguish stone from metal slicing marks created as part of the butchering process, Greenfield conducted a series of experiments to determine the relationship between the shape of slicing butchering mark on bone and the raw material of the butchering implement (metal or stone knife or other tools). The methods and techniques used in the analysis are described extensively elsewhere and we refer the reader to that literature (*e.g*. Bello and Soligo 2008; Greenfield 1999, 2006, 2013; Olsen 1988; Shipman 1981; Walker 1978).

The morphologically diagnostic profiles of grooves created by the most common butchering implements are extensively illustrated elsewhere (Greenfield 1999, 2013). The controlled experiments demonstrate that it is possible to distinguish between stone and metal knife slice marks based on the morphology of the groove. In summary, metal blades from ancient times tend to have a flat-edge with varying edge angles and widths (depending on the raw material and function of the blade). Flat edged blades tend to produce a groove in bone that is V-shaped in profile, with both sides rising steeply away from the apex at a similar angle. It is very rare to see sharp and perfect V-shaped grooves since blades become progressively duller as they are used. A perfect V-shaped groove is caused only by modern razor-like blades which are discarded after each use (*i.e*. medical scalpels). The bottom of the groove may also present itself as relatively flat if the blade has become dull. Serrated blades on the other hand, create a wide and shallow cut-mark, with the edges sloping unevenly and gradually. This is the case for a serrated knife with tightly spaced teeth. Wider serrated knives tend to show a scalloping on one side and a wide slope on the other. Both tight and wide serrated knives create an apex that has a wave that weaves itself across the surface. Metal slicing marks also tend to be deeper and smoother than stone blade marks.

There are several types of stone tool butchering marks that can appear. The most common are slices and scrapes. Chipped stone tool slice marks appear as asymmetrical V-shaped grooves, with one side descending relatively rapidly (as with a metal slice mark) and the other slope descending much more gradually. Each slope will have a different morphology due to the nature of chipped stone tool production. The steeply descending face will be relatively smooth since it reflects the smooth ventral surface of the blade. The more gently descending face will contain ridges that run parallel to the apex.

These appear as steps when viewed in profile. This side of the groove represents the uneven dorsal face that is characteristic of chipped stone blade/flakes.

The lateral ridges running parallel to the apex of the groove along its length provide information on the nature of production and retouch. When the lateral ridges are few and found on only one of the slopes, this suggests that the groove was made by a unifacially produced, but unretouched blade or flake. The difference between production and retouch has more to do with the stage of manufacture (production) and the stage of sharpening or modifying the tool from the original shape (retouch). When there are many lateral ridges on one side, it suggests that it was made by a unifacially produced, but unifacially retouched blade or flake. When there are many lateral ridges on both slopes, then it is likely that the groove was made by a bifacially retouched blade or flake. Flakes and blades cannot be distinguished. Similarly, bifacially produced tools cannot be distinguished from bifacially retouched tools. In any case, this is less relevant since blades and flakes for butchering purposes tend to be typically unifacially produced.

Scrapes appear as very shallow with slow sloping edges and the appearance of waves along one side. The very end of the scrape is where the apex can be found which sharply descends into the bone.

Analysis

Taphonomy of assemblage

Before a consideration of the frequency of stone or metal marks can be considered, the taphonomy of the assemblage must be assessed. Taphonomy can influence the quality of any assessment. For example, in a badly weathered assemblage, it is difficult to determine the nature of the groove and interpret if it was made by stone or metal instrument. A number of variables are discussed next.

Weathering

The vast majority of remains in the assemblage is only very lightly or lightly weathered (86%) attesting to its relatively high level of preservation (Table 14.3). However, this seems to decline over time. For example, the Chalcolithic (100%), Early Bronze (91%), Late Bronze (86%) and Late Roman/Byzantine (83%) all exhibit very high levels of light weathering. This distribution suggests that the bones were deeply buried soon after being discarded and not uncovered. In contrast, most of the later periods exhibit slightly lower rates of light weathering – Iron (71%), Persian (65%), Hellenistic (67%), and modern Arab (57%). The bones in all of the later periods were probably more highly weathered because they were closer to the surface of the mound.

Root marks

Very few specimens had any evidence of root damage (Table 14.4). The vast majority had no root marks (71.44%) or only very light+light root marks on them (23.64+0.85=24.5% of entire assemblage; or 85.75% of only those with root marks). This follows along with the high frequency of light weathering, which suggests that the bones with light or no weathering were not lying close to the surface after burial. The frequency of root marks appears to follow the weathering pattern. This implies that lightly weathered bones were quickly and deeply buried since there are few root marks on them. Only 0.5% of the assemblage was located near the surface and this is mostly from the Iron Age, Late

Bronze and modern Arab.

Table 14.3. Frequency distribution of butchered bone weathering by period (NISP).

Period	Very light		Light		Medium		Heavy		Unknown		Total No. NISP
	No. NISP	%	No. NISP	%	No. NISP	%	No. NISP	%	No. NISP	%	
Chalcolithic		0.00	3	100.00		0.00		0.00		0.00	3
Early Bronze	1	0.16	556	91.15	48	7.87		0.00	5	0.82	610
Late Bronze	1	0.14	605	85.94	87	12.36	3	0.43	8	1.14	704
Iron	2	2.22	64	71.11	23	25.56	1	1.11		0.00	90
Persian		0.00	11	64.71	6	35.29		0.00		0.00	17
Hellenistic		0.00	2	66.67	1	33.33		0.00		0.00	3
Late Roman/ Byzantine		0.00	49	83.05	10	16.95		0.00		0.00	59
Modern Arab		0.00	21	56.76	16	43.24		0.00		0.00	37
Total	4	0.26	1311	86.08	191	12.54	4	0.26	13	0.85	1523

Table 14.4. Frequency distribution of butchered bone with root marks by period (NISP).

Period	Very light		Light		Medium		Heavy		None		Total No. NISP
	No. NISP	%	No. NISP	%	No. NISP	%	No. NISP	%	No. NISP	%	
Chalcolithic		0.00	2	66.67		0.00		0.00	1	33.33	3
Early Bronze	7	1.15	131	21.48	16	2.62		0.00	456	74.75	610
Late Bronze	6	0.85	170	24.15	15	2.13	3	0.43	510	72.44	704
Iron		0.00	26	28.89	13	14.44	4	4.44	47	52.22	90
Persian		0.00	6	35.29	3	17.65		0.00	8	47.06	17
Hellenistic		0.00	2	66.67	1	33.33		0.00		0.00	3
Late Roman/ Byzantine		0.00	14	23.73		0.00		0.00	45	76.27	59
Modern Arab		0.00	9	24.32	6	16.22	1	2.70	21	56.76	37
Total	13	0.85	360	23.64	54	3.55	8	0.53	1088	71.44	1523

Modern damage

A large percentage of the sample shows evidence of modern damage (Table 14.5). A small percentage

(38.04%) showed no modern damage. The remaining specimens (65.92%) had evidence of modern damage either produced during excavation or during transportation of samples from the site or to the laboratory for analysis. The degree of modern damage differs by period. The Early Bronze Age shows the highest degree of modern damage (76%), with lower frequencies all subsequent periods: Late Bronze Age (58.24%), Iron Age (68.89%), Hellenistic (66.67%), late Roman/Byzantine (57.63%), Persian (52.94%) and Modern Arab (64.86%). This high degree of damage within the assemblage (over 50%, in general, and over 75% for the EB) could be interpreted as evidence that the assemblage has a poor history of preservation. However, our recent experience at Tell es-Safi/Gath where we are directly involved in the excavation of sample suggests that this is not a unique pattern. A similar fraction of bones from the EB at Tell es-Safi/Gath have modern damage in spite of all efforts at improving recovery. They fragment upon discovery due to soil conditions. While this may have repercussions for the analysis of the larger assemblage, it does not appear to affect this butchering analysis since the surfaces of the bone are not significantly weathered or pitted.

Calcium carbonate

Very few specimens have been found to exhibit calcium carbonate concretions (Table 14.6). Only 1.25% of the sample has been found with calcium carbonate. Calcium carbonate covers the surface of the bone with a hard substance that can only be removed from bones with the use of acids. Often calcium carbonate covers the surface of the bone so entirely that it is nearly impossible to examine marks on the surface. This low percentage means that nearly all of the specimens could be examined in their entirety.

Table 14.5. Frequency distribution of butchered bone with modern damage by period (NISP).

Period	*Yes*		*No*		*Total*
	No. NISP	*%*	*No. NISP*	*%*	*No. NISP*
Chalcolithic	1	33.33	2	66.67	3
Early Bronze	462	75.74	148	24.26	610
Late Bronze	410	58.24	294	41.76	704
Iron	62	68.89	28	31.11	90
Persian	9	52.94	8	47.06	17
Hellenistic	2	66.67	1	33.33	3
Late Roman/Byzantine	34	57.63	25	42.37	59
Modern Arab	24	64.86	13	35.14	37
Total	1004	65.92	519	34.08	1523

Table 14.6. Frequency distribution of butchered bone with calcium carbonate encrustation by period (NISP).

Period	Yes		No		Total
	No. NISP	%	No. NISP	%	No. NISP
Chalcolithic		0.00	3	100.00	3
Early Bronze	6	0.98	604	99.02	610
Late Bronze	3	0.43	701	99.57	704
Iron	5	5.56	85	94.44	90
Persian	2	11.76	15	88.24	17
Hellenistic		0.00	3	100.00	3
Late Roman/Byzantine	2	3.39	57	96.61	59
Modern Arab	1	2.70	36	97.30	37
Total	19	1.25	1504	98.75	1523

Heat treatment

Each of the bones was evaluated for thermal alteration using traditional zooarchaeological techniques based on colour and texture (*cf*. Shipman 1984). Most of the remains do not appear to be heat treated (87.59%). In total 189 specimens were either possibly or definitely heat modified (Table 14.7). The largest portion appears to be from specimens that were boiled (66.41+13.76=80.17%). This has significance for understanding the next category – tool making.

Tool polish

A larger than expected percentage of the Tell Halif assemblage has evidence of possible tool polish (Table 14.8). A total of 58% of the assemblage has evidence of some level of polish. The polish seen on the surface of the bones was ranked according to intensity. Light polish was the most common (29%), followed by medium polish (22%), heavy polish (6%) and very light polish (0.07%). The Early Bronze Age assemblage has the largest portion of polished specimens (69.67%). This shows that a very high proportion of the bones with slicing marks were used as tools. This brings up the issue of whether the slice marks really represent butchering or tool making activities. The proportion of bones without any polish (blank category) appears to be much higher during the LB and subsequent periods. What sets these other periods apart from the EB is that metal tools are being used progressively more often.

Table 14.7. Frequency distribution of butchered bone with evidence of heat treatment by period (NISP).

Period	Burn		Possible burn		Boil		Possible boil		Total No. NISP
	No. NISP	%	No. NISP	%	No. NISP	%	No. NISP	%	
Early Bronze	22	18.03	1	0.82	87	71.31	12	9.84	122
Late Bronze	8	15.69	1	1.96	30	58.82	12	23.53	51
Iron	3	42.86		0.00	3	42.86	1	14.29	7
Persian	3	100.00		0.00		0.00		0.00	3
Late Roman/ Byzantine		0.00		0.00	4	100.00	0	0.00	4
Modern Arab		0.00		0.00	1	50.00	1	50.00	2
Grand Total	36	19.05	2	1.06	125	66.14	26	13.76	189

Table 14.8. Frequency distribution of butchered bone with tool surface polish by period (NISP).

Period	Very light		Light		Light on shaft, heavy on tip		Medium		Heavy		None		Total No. NISP
	No. NISP	%	No. NISP	%	No. NISP	%	No. NISP	%	No. NISP	%	No. NISP	%	
Chalcolithic		0.00	2	66.67		0.00	1	33.33		0.00		0.00	3
Early Bronze	4	0.66	194	31.80		0.00	157	25.74	70	11.48	185	30.33	610
Late Bronze	6	0.85	181	25.71	1	0.14	151	21.45	18	2.56	347	49.29	704
Iron	2	2.22	27	30.00		0.00	15	16.67	2	2.22	44	48.89	90
Persian		0.00	4	23.53		0.00	1	5.88	1	5.88	11	64.71	17
Hellenistic		0.00	1	33.33		0.00		0.00		0.00	2	66.67	3
Late Roman/ Byzantine	2	3.39	17	28.81		0.00	7	11.86	3	5.08	30	50.85	59
Modern Arab		0.00	10	27.03		0.00	6	16.22		0.00	21	56.76	37
Total	14	0.92	436	28.63	1	0.07	338	22.19	94	6.17	640	42.02	1523

Canid gnaw marks

Very few bones exhibited any evidence of canid gnaw marks (8.86% of overall assemblage; Table 14.9). This shows that canids were not a significant taphonomic factor affecting the butchered bone assemblage.

Stone versus metal marks

Metal tool marks make up a larger portion (57.48%) of the assemblage, while stone tools make up the remainder (42.52%). However, the frequency changes between metal and stone tool marks changes within and between each major period. There is no evidence for metal marks in the Chalcolithic sample. Metal tools begin to make an appearance during the EB (Table 14.10), but in very small

quantities (*ca*. 5%). The vast majority of EB slicing marks are made by chipped stone tools (95%; Fig. 14.2). There are no MB deposits with butchering marks at the site. In the LB, the sample shows a dramatic increase in the number of metal tool marks (metal = 85%, stone = 15%; Fig. 14.3). In subsequent periods, metal marks continue to dominate the assemblage. It is very interesting to note that stone tool marks continue to be present in all subsequent periods (except for the tiny Hellenistic sample), including the modern Arab period.

Table 14.9. Frequency distribution of butchered bones with canid gnawed bone by period (NISP).

Period	Canid		Possible gnaw marks		Rodent		None		Total No. NISP
	No. NISP	%	No. NISP	%	No. NISP	%	No. NISP	%	
Chalcolithic	1	33.33		0.00		0.00	2	66.67	3
Early Bronze	39	6.39		0.00	1	0.16	570	93.44	610
Late Bronze	75	10.65		0.00	1	0.14	628	89.20	704
Iron	7	7.78		0.00		0.00	83	92.22	90
Persian		0.00	1	5.88		0.00	16	94.12	17
Hellenistic		0.00		0.00		0.00	3	100.00	3
Late Roman/ Byzantine	7	11.86		0.00	1	1.69	51	86.44	59
Modern Arab	2	5.41		0.00		0.00	35	94.59	37
Grand Total	131	8.60	1	0.07	3	0.20	1388	91.14	1523

Table 14.10. Frequency of butchered bone with metal vs. stone tool marks by major period, excluding indeterminates (NISP).

Period	Stone		Metal		Total # NISP
	# NISP	%	# NISP	%	
Chalcolithic	3	100.00%	0	0.00%	3
Early Bronze	428	94.90%	23	5.10%	451
Late Bronze	90	14.85%	516	85.15%	606
Iron	3	3.49%	83	96.51%	86
Persian	3	18.75%	13	81.25%	16
Hellenistic	0	0.00%	3	100.00%	3
Late Roman/Byzantine	2	3.51%	55	96.49%	57
Modern Arab	5	14.71%	29	85.29%	34
Grand Total	**534**	**42.52%**	**722**	**57.48%**	**1256**

When the frequency of marks is examined more closely by sub-periods, it is possible to understand the transition between stone and metal technologies (Table 14.11). Metal marks are not

present in EB I. They initially appear in the EB III in very small quantities (*ca*. 5%). There is no EB II, EB IV and MB II at the site. Throughout the LB, the frequencies are dramatically higher with a shift to primarily metal tool marks. In the LB I, metal marks are 81.4% of the assemblage. Metal marks continue to increase in importance in the LB II (87.8%). Given this information, the frequency of metal tool marks initially appears in EB III, and grows in importance over time. However, stone tool slicing marks never completely disappear, even in modern times.

Fig. 14.2. Butchering specimen 2: Gazella gazella phalange 1 with stone tool butchering marks on caudal/plantar face (MC: 53617.1; Field: 101; Locus: 90023; Year: 1987; Fill code: 41, Foundation Trench Debris; Stratum: 16; Period: EB IC).

Fig. 14.3. Butchering specimen 19: Ovis aries distal scapula with metal tool butchering marks on medial face (MC: 21130; Field: I; Area 10: Locus: 10076; Year: 1983; Fill code: 11 Pit Fill (Refuse); Stratum: 11; Period: LB IA).

Table 14.11. Frequency of Early and Late Bronze sub-periods butchered bones with metal vs. stone marks, excluding unknowns (NISP).

Raw material	*Stone*		*Metal*		*Total # NISP*
Period	*# NISP*	*%*	*# NISP*	*%*	
Early Bronze	**428**	**94.90%**	**23**	**5.10%**	**451**
I	**17**	**100**	**0**	**0.00%**	**17**
A	12	100.00%	0	0.00%	12
B	4	100.00%	0	0.00%	4
C	1	100.00%	0	0.00%	1
III	**411**	**94.70%**	**23**	**5.30%**	**434**
A1	50	90.91%	5	9.09%	55
A2	123	96.85%	4	3.15%	127
B1	48	90.57%	5	9.43%	53
B2	190	95.48%	9	4.52%	199
Late Bronze	**90**	**14.85%**	**516**	**85.15%**	**606**
I	**47**	**18.58%**	**206**	**81.42%**	**253**
A	32	23.53%	104	76.47%	136
ABC	1	50.00%	1	50.00%	2
B		0.00%	14	100.00%	14
C	2	18.18%	9	81.82%	11
D		0.00%	2	100.00%	2
Unknown	12	13.64%	76	86.36%	88
II	**43**	**12.18%**	**310**	**87.82%**	**353**
A	8	12.50%	56	87.50%	64
B	35	12.11%	254	87.89%	289
Grand Total	**518**	**49.01%**	**539**	**50.99%**	**1,057**

Butchering efficiency

Butchering efficiency can be monitored by examining the number (*i.e*. average) of slices found in each butchering incidence and by NISP (Table 14.12). The number of slices that were observed under light optical microscope for each butchering incidence and NISP were summed and then divided by the number of cases (in this case, the number of incidences). There could be one or more incidences (as defined by a single or cluster of marks) on any individual bone specimen. The patterns in the data for both measures are very similar and follow strong temporal patterns of increasing efficiency.

Table 14.12. Frequency distribution of total number of slicing marks divided by the number of butchering incidences (cases) and NISPs as a reflection of butchering efficiency (excluding unknowns).

Raw material	Stone slices				Metal slice						
Period	#slices (under micro-scope)	Average/BI	# NISP with butcher marks	Average/NISP	#slices (under micro-scope)	Average/BI	# NISP with butcher marks	Average/NISP	Total #slices (under micro-scope)	Difference between stone and metal efficiency/BI	Difference between stone and metal efficiency/NISP
Chalcolithic	42	10.50	3	14.00	0	0.00	0	NA	42	NA	NA
Early Bronze	7,449	13.28	428	17.40	161	5.37	23	7.00	7,610	40.42%	40.22%
Late Bronze	1,455	11.73	90	16.17	5,111	7.58	516	9.91	6,566	64.63%	61.27%
Iron	31	10.33	3	10.33	585	6.57	83	7.05	616	63.61%	68.21%
Persian	8	2.67	3	2.67	56	4.67	13	4.31	64	175.00%	161.54%
Hellenistic	0	0.00	0	NA	32	6.40	3	10.67	32	NA	NA
Late Roman/ Byzantine	14	7.00	2	7.00	621	9.00	55	11.29	635	128.57%	161.30%
Modern Arab	102	20.40	5	20.40	182	6.28	29	6.28	284	30.76%	30.76%
Grand Total	*9,101*	*12.96*	*534*	*17.04*	*6,748*	*7.43*	*722*	*9.35*	*15,849*	*40.42%*	*54.84%*
Average for pre-Persian periods		*11.46*				*4.88*				*42.58%*	*82.81%*

With the introduction of metal tools for butchering, there appears to be an increase in the butchering efficiency that continues over time. When the total number of slices visible under a microscope is divided by the NISP for each period (second to last column of Table 14.12), butchering efficiency dramatically increases from the Early Bronze Age (40%), through the LBA (64%), Iron Age (63%), Persian (175%) and Late Roman/Byzantine (128%). A decline is only seen in the modern Arab material. An even stronger pattern is apparent when the total number of slices visible under a microscope is divided by the NISP for each period (in the last column of Table 14.12). In this case, it is apparent that the efficiency of butchers dramatically increases from the EB (40%), through the LBA (61%), Iron Age (68%), Persian (161%) and Late Roman/Byzantine (161%). A decline is only seen in the modern Arab material. The grand total frequency of slice marks/incidence declines by almost 40.4% when average frequency for metal (x =7.43) and stone tool slices (x =12.96) is compared. This pattern continues across nearly all of the pre-Persian periods (Chalcolithic–Iron Age), where the average is 42.6%.

When the data are broken down by periods, more subtle patterns can be visualized. The average number of stone slice marks in the Chalcolithic is 10.5/incidence (or 14/NISP). This pattern of average number of stone tool slicing marks continues in the Early Bronze (x =13.3 BI; 17.4 NISP), Late Bronze (x =11.3 BI; 16 NISP), and Iron Age (x =10.3 BI; 10.3 NISP). In the same periods, metal tools display a far lower average number of slices per incidence: Early Bronze (x =5.3 BI; 7 NISP), Late Bronze (x

=7.5 BI; 9.9 NISP), and Iron Age (x =6.5 BI; 7 NISP). This suggests an increase in efficiency with the introduction of metal tools in the butchering process.

This pattern, however, is not found with two of the post-Iron Age periods: *i.e*. Persian and late Roman/Byzantine periods. In these cases, the number of metal marks/bone far exceeds that of stone (x =2.67 BI stone *vs*. 4.67 BI for a 175% increase in Persian; and x =7 stone BI *vs*. 9 BI for a 128.6% increase in Late Roman/Byzantine). This probably reflects the advent of the introduction of far superior metal (*e.g*. steel) during this period across the Near East. It is not clear what the meaning of the decline in efficiency that occurs with the subsequent period (modern Arab), where it reverts to the pattern seen in the pre-Persian periods. The difference in efficiency between the average number of stone and metal tool marks declines to the level seen in the EB (30.8% – stone x =20.4, metal x =6.3 BI and NISP).

Can these patterns be statistically validated? Given our interest in documenting the spread of metal butchering technology between the EB and LB, we conducted a Fisher exact and chi square test statistic on the data in Tables 14.10 and 14.12 on the data from these two periods. In both cases, the results are significant at $p<0.05$. However, it is not possible to determine if the patterns seen in the post-Iron Age data are significant given the highly varying level of frequencies from one period to the other. As more data are collected in future years, this problem should be abated.

Conclusions

Through the analysis of the morphology of butchering marks from Tell Halif, several long-term patterns are visible. First, stone tools continue to be used for butchering right up to modern times. This is evident from the substantial presence of stone tool slicing marks that derive from the modern Arab associated deposits at the site.

Second, metal tool marks for butchering purposes at Tell Halif appears much later in time than originally expected. In spite of the fact that bronze tools appear early in the EB, metal butchering marks only begin to appears in the EB III. However, it is present in very small quantities throughout each of the EB III sub-periods.

Third, it is not until the LB I at Tell Halif that metal tool marks constitute the majority of butchering marks. This suggests a dramatic shift in the nature of butchering implement raw material between the end of the EB and beginning of the LB. From other sites in the region, this transition appears to happen in the MB (Greenfield 2013). In any case, the transition to metal butchering technology at Tell Halif appears to occur almost 1,000 years after bronze knives were first introduced to the region (Philip 1989). These patterns confirm the results obtained through a similar analysis at many other archaeological sites in the southern Levant. Clearly, metal takes a long time to be adopted for butchering technology even though it would be more efficient. However, it does not mean that all people can or will quickly adopt it.

Fourth, most stone tool slicing marks were made by simple unretouched flakes and/blades. This implies that the stone tool production for butchering was relatively unspecialized and *ad-hoc*.

Fifth, the difference in frequency between average number of slicing marks/incidence found on the surface of bones from Tell Halif illustrates the reasons for why metal ultimately replaced stone as the preferred butchering implement. Metal implements require fewer strokes to cut through soft tissue during the butchering process. Hence, they are more efficient in the butchering process. However, one

should not assume that metal tools are more efficient to produce than stone. Stone tools are made of raw materials that are more readily available. The sources are widespread through the region and easily available. Also, it is relatively easy to produce chipped stone tools for butchering since most of them are simple flakes or blades. Hence, the acquisition and production of stone tools requires less energy and production time with less specialisation than is required for metal tools. The limitation of stone tools is that they lose their cutting edge quickly and are difficult to sharpen. As a result, they are used for shorter periods of time and discarded more readily. In contrast to stone tools, metal tools can be easily sharpened and will have greater longevity in the butchering process. Metal tools require less energy to cut through more tissue with fewer strokes. However metal tools require much greater investment in the procurement of raw materials and manufacturing since their sources are usually not local (and are often imported over great distances) and require specialised facilities to produce and repair. As a result, metal tools will be more expensive to acquire and maintain over time. This will affect the rate of adoption of this new technology for mundane activities.

Sixth, the decline in average frequency of slice marks/incidence coincides with the introduction of bronze metallurgy for butchering in the region. The absence of metal marks in the Chalcolithic is largely a result of the fact that copper is not suitable for holding a sharp cutting edge. Once copper is alloyed with tin, a harder edge is achieved. This happens later in the EB (III) and this is when we begin to see the appearance of some metal slice marks. The small frequency of metal tool marks in the EB is probably a reflection of the very limited availability of such tools for mundane tasks, such as butchering of animals. This pattern changes in the LB where the frequencies of metal tool marks are much higher. Various factors (*e.g*. such as increased availability of bronze, decline in its cost, wider distribution in society, *etc*.) led to the increase in use of metal tools by the Late Bronze Age and its more widespread use in mundane activities.

The transition from stone to metal allowed for new butchering methods to be employed, and an overall improvement in efficiency consequently occurred in the butchering process. Many economic and political changes also occurred during the Bronze Age. Detailed analysis of butchering marks allows us to examine the impact of the introduction of metal on these economic and political changes in an entirely new manner.

Acknowledgements

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Chapter 15

Class and "Romanization" in Late Roman Egypt: Issues of Identity and the Faunal Remains from the Site of Amheida in the Dakleh Oasis, Western Egypt

Pam J. Crabtree and Douglas V. Campana

The site of Amheida, a Late Roman site in the Dakleh Oasis in Western Egypt, has been excavated by Prof. Roger Bagnall of New York University since 2001. Excavations at the site, known in antiquity as Trimithis, have focused on three areas. Substantial animal bone collections have been recovered from two of these areas within the site included in this paper. Area 2 represents a large and well-appointed villa (town house) with extensive wall paintings, while Area 1 was a more modest middle-class home. Comparison of the two assemblages allows us to address possible class differences in animal use and diet in Late Roman Egypt. The question of "Romanization" is a contentious one that has challenged scholars working in various regions of the Roman Empire. This paper will ask whether and to what extent the diet choices made by wealthy and middle-class households at Amheida represent expressions of Roman identity. The Amheida data will also be compared to the faunal remains from the neighboring Late Roman rural site of Ain al Gedida.

Archaeological background

Amheida (Fig. 15.1), the ancient city known as Trimithis in Roman times, has been the focus of intensive archaeological research since 2001. The site is located in Dakleh Oasis, one of seven oases located in Egypt's Western Desert about 350 km from the Nile River. The excavations at Amheida are directed by Professor Roger Bagnall of the Institute for the Study of the Ancient World (ISAW) at New York University. The Amheida excavations are part of the broader Dakleh Oasis Project that seeks to trace the long-term relationships between the environment and human settlement in the region from the beginnings of human settlement during the Pleistocene to modern times. The Amheida project was initially conducted under the auspices of Columbia University, but it has been sponsored by New York University since 2008, with Columbia University as a partner.

Excavations at Amheida have centered on three areas of the site: an upper-class fourth century house that was decorated with wall paintings, along with the adjacent school and underlying baths

(Area 2); a more modest, middle-class dwelling from the third century (Area 1); and a Temple of Thoth that was constructed in the first century CE. Well-collected animal bone assemblages were recovered from both Areas 1 and 2. Additional faunal remains were recovered from the nearby site of Ain el-Gedida which includes a fourth-century church located in the center of a series of domestic buildings (Aravecchia 2009). This site was excavated between 2006 and 2008 under the direction of Professor Roger Bagnall. The faunal assemblage comes from domestic contexts that may extend into the fifth century CE, and the site is far more rural than Amheida.

We were invited to join the Amheida Project as zooarchaeologists beginning in the 2010 season. During January of 2010 we examined the faunal remains from Area 1 which were scheduled for publication (Boozer 2015; Crabtree and Campana 2015), and we examined most of the sizable faunal collection that was recovered from Area 2. In 2011 we completed the analysis of the Area 2 animal bones and examined the faunal materials that had been recovered as part of the earlier Ain al-Gedida excavations. These three well collected faunal assemblages provided a unique opportunity to examine questions of class and Roman identity in late Roman Egypt.

Materials and methods

A small faunal collection including 535 animal bones and fragments was recovered from the Area 1 excavations (see Crabtree and Campana (2015) for a detailed discussion of the Area 1 materials). The animal bones were recovered using one-quarter inch mesh screening. A much larger faunal assemblage, 10,556 fragments, was recovered from the fourth-century villa excavated in Area 2. An additional 1,942 animal bones and fragments were recovered from the Ain al-Gedida excavations. These faunal materials were analyzed in the field laboratory at the Amheida dig house in 2010 and 2011. Since we did not have access to a comparative collection, we relied on standard identification guides (*e.g.* Schmid 1972) and our collective experience working on faunal assemblages from Europe and the Middle East. We photographed any specimens that required additional study. Otherwise, our methods were quite standard. We recorded bone measurements following von den Driesch (1976), and we recorded wear on mandibles and mandibular teeth following Grant (1982). We examined each bone fragment for traces of pathology and/or butchery, and we recorded all our identifications using FAUNA, a specialized database for archaeozoology (Campana 2010).

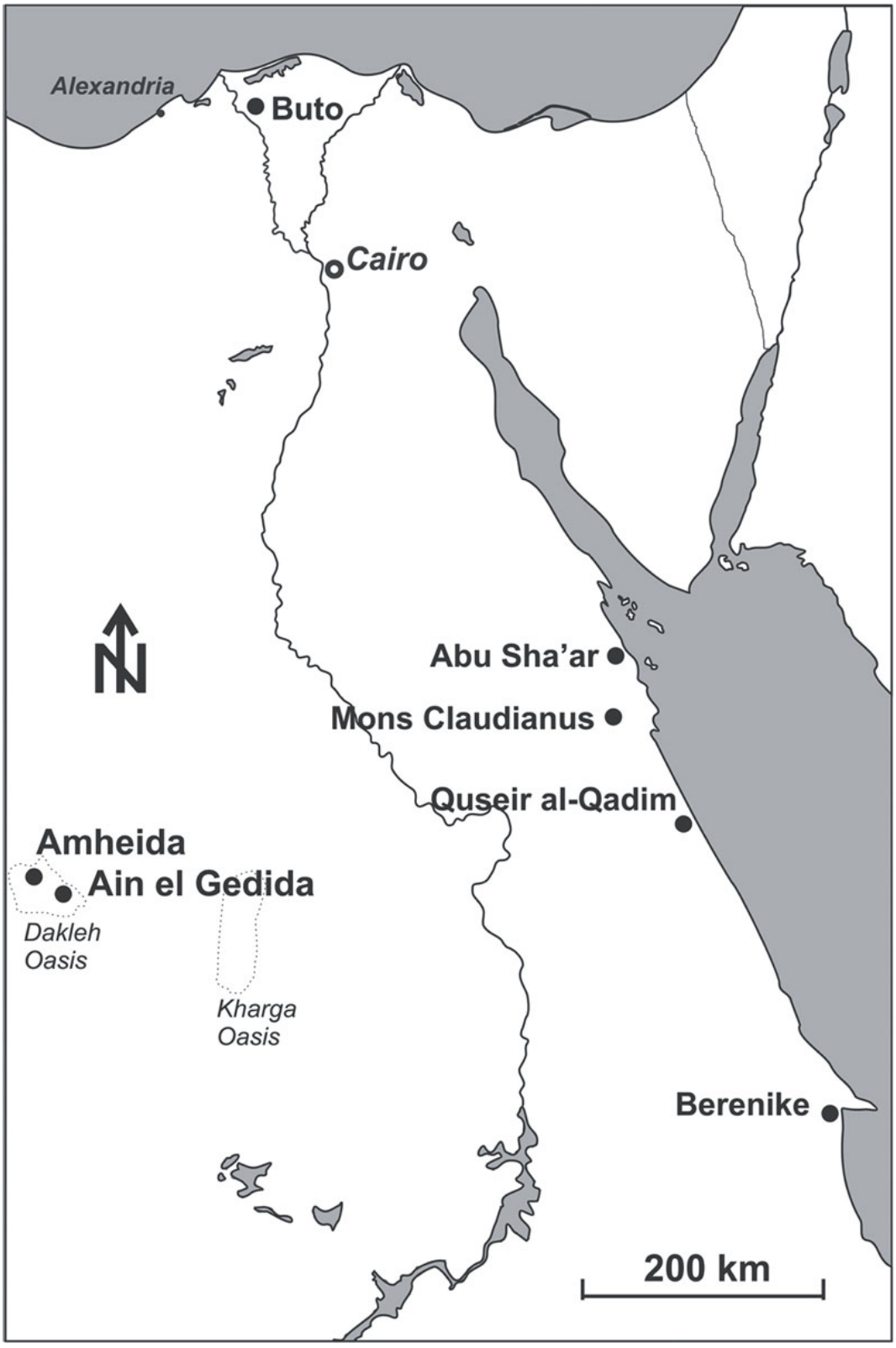

Fig. 15.1. Map of Egypt showing the location of the sites discussed in this paper.

Amheida Area 1

The faunal collection that was recovered from Area 1 was small, and many of the bones that were recovered came from Room 3, an area of the house that was associated with food production and craft activities (see Crabtree and Campana (2015) for a room-by-room breakdown of the faunal remains

from Amheida Area 1). The faunal remains recovered from Area 1 are shown in Table 15.1. The presence of both camel and donkey bones in the assemblage is particularly interesting, since documentary records indicate that the inhabitants of this area were engaged in donkey and camel driving, and a possible saddle blanket for a donkey was recovered from one of the rooms in Area 1. There are no traces of butchery on these bones, and it is not clear whether or not they formed part of the Area 1 diet. Cattle also played a substantial role in the Area 1 diet, while sheep and goats were relatively rare. Domestic chicken bones were also quite common, and the presence of eggshell fragments in Room 4 indicates that they were kept for their eggs as well as their meat. Small numbers of remains of dorcas gazelles indicate that the Area 1 diet was supplemented by hunting. Even though the assemblage is small, the total absence of pig remains is particularly striking.

Table 15.1. Animal bones identified from Amheida Area 1. Amheida Area 2, and Ain al-Gedida. Unidentified fragments and bones that were identified to higher order categories (e.g. small artiodactyl) have been excluded.

	Amheida Area 1	*Amheida Area 2*	*Ain al-Gedida*
Domestic mammals			
Donkey (*Equus asinus*)	22	21	58
Cattle (*Bos taurus*)	20	240	32
Sheep (*Ovis aries*)	0	5	2
Goat (*Capra hircus*)	0	23	6
Sheep/goat	3	62	58
Camel (*Camelus dromedarius*)	5	8	0
Pig (*Sus scrofa*)	0	1,037	240
Dog (*Canis familiaris*)	0	0	47
Cat (*Felis catus*)	0	0	5
Wild Mammals			
Gazelle (*Gazella dorcas*)	4	21	3
Domestic Birds			
Chicken (*Gallus gallus*)	13	593	8
Pigeon (*Columbia livia*)	0	1	0

Amheida Area 2

Amheida Area 2 includes a Roman villa or town house with elaborate wall paintings featuring pagan gods and goddesses, an adjacent school, and an underlying bath complex. A reproduction of the villa is currently under construction, and it will serve as a future visitor center. The villa also yielded a large, diverse, exceptionally well-preserved faunal assemblage. The animal bones identified are shown in Table 15.1. The striking feature of the Area 2 assemblage is the high number of pig remains. The species percentages for the large domestic mammals (excluding commensals) are shown in Table 15.2

and Figure 15.2. These percentages were calculated based on NISP following Lyman (2008). McKinnon (2010) has suggested that high proportions of pig bones are often associated with Roman sites in the Mediterranean world, but it is also worth noting that pig remains are commonly recovered from Egyptian sites from the earlier dynastic periods. Although the Area 1 assemblage is small, it produced no pig bones, while pigs make up nearly 75% of the large domestic mammal remains in Area 2.

Both Areas 1 and 2 produced substantial numbers of chicken bones. Chickens would have been a useful source of primary and secondary products including eggs, feathers, and meat. Most of the chickens recovered are older birds. The Area 2 assemblage also produced a single bone of pigeon. Today the areas in and around Amheida are covered with dovecotes, and pigeon seems to have formed at least an occasional part of the fourth-century diet.

Both Area 1 and Area 2 yielded small numbers of gazelle (*Gazella dorcas*) remains. The areas around the Dakleh Oasis would have had a richer wild fauna in Late Pleistocene and Early Holocene times, but with the exception of the gazelle, the other large wild mammals had been extirpated by the Late Roman period.

Ain al-Gedida

The animal bones assemblage from Ain al-Gedida provides an interesting contrast to the faunal remains recovered from Areas 1 and 2 at Amheida, in that it is a rural assemblage and the site may have continued its occupation into the fifth century. The faunal remains from Ain al-Gedida were less well preserved than those from Amheida. Many showed traces or burning and rodent gnawing, and 20 rodent bones, including 12 that are provisionally identified as black rats (*Rattus* sp.), were identified in the faunal assemblage. A number of other bones were encrusted with salt deposits, which also led to fragmentation. Unlike Amheida, the Ain al-Gedida assemblage yielded the remains of both cats and dogs, commensal species that would be at home in a rural environment. However, the overall pattern of faunal use at Ain al-Gedida is quite similar to Area 2 at Amheida. Like Area 2, Ain al-Gedida is dominated by the remains of pigs. Smaller numbers of chicken bones were recovered from Ain al-Gedida, and camel remains were totally absent. However, Ain al-Gedida yielded a higher proportion of donkey remains than Area 2, and these animals may have played an important role in agricultural labor. There are no butchery traces on these bones, so they were probably not part of the diet at the site. Cattle were certainly part of the diet at Ain al-Gedida, but three first phalanges show evidence for lipping on the proximal joint surface. This pathological condition is likely to be the result of traction, *i.e*. the use of cattle to pull ploughs and carts (Bartosiewicz *et al*. 1997). These cattle may have ended up as food when their working lives were over.

Table 15.2. Species ratios based on NISP for the large domestic mammals from Amheida Area 1, Amheida Area 2, and Ain al-Gedida.

	Area 1 N	*Area 1 %*	*Area 2 N*	*Area 2 %*	*Gedida N*	*Gedida %*
Donkey	22	44.0	21	1.5	58	14.6
Cattle	20	40.0	240	17.2	32	8.1
Sheep + Goat	3	6.0	90	6.4	66	16.7
Camel	5	10.0	8	5.7	0	0.0
Pig	0	0.0	1037	74.3	240	60.6

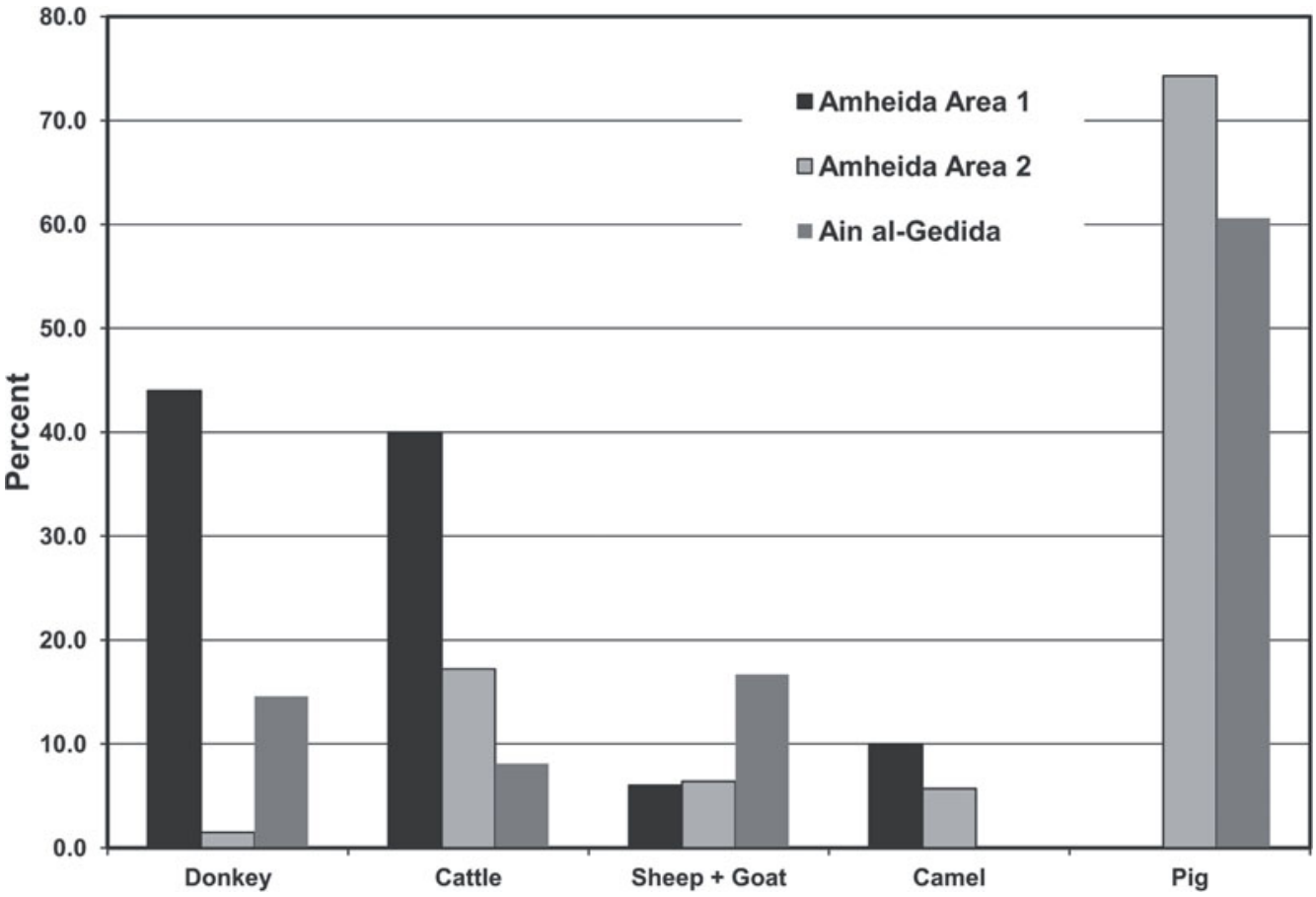

Fig. 15.2. Species percentages based on NISP for the large domestic mammals from Amheida Area 1, Amheida Area 2, and Ain Al Gedida.

Discussion

To what extent can these assemblages be used to address the questions of identity in late Roman Egypt? The Area 1 faunal remains were derived from a middle-class household that was engaged in donkey and camel driving, and the presence of these species in the faunal collection should come as no surprise. Donkeys were initially domesticated in Africa, and early domesticated donkeys have been identified from the First Dynasty site of Abydos (Rossel *et al*. 2008). Although camels were domesticated on the Arabian Peninsula, they appear in the Nile Valley in the early part of the first millennium BCE (Rowley-Conwy 1988). The remainder of the assemblage includes cattle and caprine remains, supplemented by a few gazelle bones. In many ways, this is a very traditional Egyptian

assemblage. Cattle and goats have been raised in the Dakleh area since the Neolithic (van Zoest and Kaper 2006:4). The only feature of the Area 1 assemblage that can possibly be described as Roman is the presence of the domestic chicken. While chickens were introduced to Egypt in the New Kingdom, they did not become widespread until about a millennium later. Chicken remains are common on Roman sites throughout the Empire. With the exception of the chicken bones, the Area 1 assemblage can be seen as generally Egyptian in character.

The questions of Roman identity and "Romanization" are challenging ones for contemporary archaeology. While early twentieth-century scholars saw the gradual adoption of Roman identity and material culture in the conquered provinces as almost inevitable (Haverfield 1913), contemporary scholars recognize that the interrelationships between the colonizers and the colonized are far more complex (see, for example, Hingley 2000). However, the character of the faunal assemblages from Amheida Area 2 and Ain al-Gedida is very different from Area 1. The major difference is the importance of pork in the diet. At both Amheida Area 2 and Ain al-Gedida pig remains make up a majority of the identified large mammal bones, and they approach 75% in Area 2. Pigs are totally absent in Area 1. McKinnon (2010) has shown that increased pork consumption is a characteristic of Roman sites throughout the Mediterranean, and there is no reason to assume that this would not be true of Egypt as well. The large numbers of chickens seen in Area 2 are also typical of Roman sites throughout the Empire. The owner of the Area 2 villa was a wealthy Roman pagan, whose religious preferences were proudly displayed in the wall paintings that decorated his dining room. There is every reason to suspect that he is also expressing his upper-class Roman identify though his choices of foods such as pork and chicken. The rural assemblage from Ain al-Gedida is a bit less Roman in character. While pig remains make up about 60% of the large domestic mammal remains, chicken remains are relatively rare, and sheep and goats play a somewhat larger role in the diet.

Comparisons with other Roman period sites in Egypt

This is a study based on only two seasons of study in Egypt, and the faunal assemblages from Area 1 at Amheida and Ain al-Gedida are relatively small. There are relatively few other studies of faunal remains from Roman-period Egyptian sites (Crabtree and Campana 2015). Most of the sites that have been studied are located along the Red Sea and in the Eastern Desert, far from the Western Oases. In our forthcoming publication on the Area 1 fauna from Amheida (Crabtree and Campana 2015), we compared the Area 1 assemblage to the faunal material from Mons Claudianus in the Eastern Desert (Hamilton-Dyer 2001) and to Berenike on the Red Sea coast (Van Neer and Ervynck 1999). In this paper we also include comparisons to the fauna of Abu Sha'ar and Quseir al Qadim on the Red Sea coast (Van Neer and Sidebotham 2002; Wattenmaker 1979, 1982) and to Buto in the Nile Delta (von den Driesch 1997).

Abu Sha'ar was a Roman fort on the Red Sea coast that was abandoned in the fourth century. In the late fourth or early fifth century it was reoccupied and converted into a Christian monastery. The faunal remains were dominated by fish bones, both in terms of the number of fragments and in terms of the number of species. Fish, mollusks, turtles, and dugongs formed a major part of the diet at Abu Sha'ar (Van Neer and Sidebotham 2002: 188). Marine fish alone made up more than 80% of the faunal remains identified from the fourth- and fifth-century contexts (Van Neer and Sidebotham 2002: 193, fig. 5). Marine resources were supplemented by mammal- and bird-hunting; domestic animals were

quite rare.

Mons Claudianus was a fort in the Eastern Desert. Hamilton-Dyer (2001: 251) suggested that the site was probably provisioned by pack animals. The most common mammal remains were equids, followed by pigs, sheep and goats, and camels. What is surprising about the Mons Claudianus is the presence of at least 30 species of fish. Most are marine species, but a smaller number of freshwater fish were also identified (Hamilton-Dyer 2001: 284).

Berenike was trading town on the Red Sea that was occupied from the first through the sixth centuries CE. Marine fish played an important role throughout the town's occupation; 100 different fish taxa have been identified (Van Neer 1997: 142). Domestic animals include sheep, goats, cattle, camels, pigs, and chickens, but the proportions of both pigs and chickens declined in the Late Roman period (Van Neer and Ervynck 1999: 330). Van Neer (1997: 143) has suggested that the higher proportion of pigs in the Early Roman features at Berenike may reflect the presence of non-Egyptian Roman troops and that the decline in pigs may be linked to "a decrease in the proportion of Romanized subjects at Berenike."

Quseir al-Quadim is located on the Red Sea coast at the end of the route through the central desert. Small faunal assemblages from Early Roman features were identified by Wattenmaker (1979, 1982). Marine resources, including fish, mollusks, and sea turtles played an important role in the diet. The fish were supplemented by mammals, including caprines, pigs, cattle, and camels. Van Neer (1997: 140) estimates that 80% of the domestic mammal remains were sheep and goats. Only a few chicken bones were recovered from Quseir al-Quadim, and there was no evidence for hunting. Wattenmaker (1979, 1982) suggested that the pigs and cattle were imported from the Nile Valley while the sheep and goats were obtained from pastoral specialists.

The Red Sea coast and Eastern Desert faunal assemblages from the Roman period are very different from the Amheida material. All the assemblages from eastern Egypt include substantial quantities of fish. No fish were recovered from Amheida Area 1 despite fine screening, and only 25 fish fragments were recovered from the large Area 2 faunal sample. None of these eastern assemblages show the high numbers of pigs that are seen at Amheida Area 2 and Ain al-Gedida.

The excavations at the ancient town of Buto in the western Nile Delta revealed very different patterns of animal exploitation during the Roman period in Egypt. Excavations at Buto were carried out between 1985 and 1987 by the German Archaeological Institute, and archaeological and zooarchaeological remains dating from the late prehistoric (Naqada II) through the Roman period were unearthed. While faunal material from the prehistoric and the Old Kingdom contexts provided substantial evidence for pig husbandry, pigs played a very minor role in the Roman period assemblage. The Roman faunal assemblage was dominated by cattle. Cattle made up 73% of the large domestic mammal remains, while pigs make up only 5%. The percentage of cattle seen at Buto is much higher than the percentages seen at Amheida Area 1, Amheida Area 2, and Ain Al-Gedida (Table 15.2). In addition, only a single chicken bone was recovered from the Roman levels at Buto, while chickens played a more substantial role in the Dakleh sites.

In sum, neither the Roman-Period faunal material from Buto in the Nile Delata, not the faunal remains from the Roman sites along the Red Sea and the Eastern Desert show close similarities to the patterns of animal use seen in the Dakleh Oasis. Many more Roman-period faunal collections need to be studied before we can truly understand the degree to which Roman colonization led to changes in

diet and subsistence in Egypt and especially in the Egyptian western oases.

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Chapter 16

Meat Consumption Patterns as an Ethnic Marker in the Late Second Temple Period: Comparing the Jerusalem City Dump and Qumran Assemblages

Ram Bouchnik

This work presents preliminary comparisons between archaeological remains of animal bones from the late Second Temple Period sites of Jerusalem and Qumran in relation to religious texts on slaughter and butchery practices from the Mishnah and the Talmud, and suggests tentative correspondence between the butchery tradition practiced and Jewish law. This is evidenced by the composition of the animal bones that were recently excavated at the Kidron city dump of Jerusalem and in animal-bone burials from the Qumran plateau.

The bones from the Kidron and Qumran excavations indicate that only kosher animals were consumed in these settlements. The age at death of cattle, sheep and goats suggests that the animals were raised and utilized predominately for their meat in Jerusalem, while at Qumran they were also used for their secondary products (wool/hair and milk for caprine, milk and labor for cattle). Pathological conditions occurred rarely, which accords well the requirement under Jewish law for the slaughter of healthy animals only. Also, the butchery marks found on the animal remains suggest that slaughtering activities were conducted by qualified slaughterers. That said, the bone assemblages lack hind-limb bones with marks of nikur, a practice that would indicate the Jewish origin of the slaughterers. Nikur involves removing the sciatic nerve and is the only Jewish butchery tradition that is expected to leave recognizable marks on pelvis and hind-limb bone elements. It is possible that the lack of evident for nikur in Jerusalem and Qumran is due to traditions change over periods; this phenomenon requires further study.

In summary, the composition of animal findings and the lack of non-kosher animals are, at the current stage of the research, the most significant ethnic fingerprint for the Jewish ethnicity of the inhabitants of Judea in the late Second Temple period.

Introduction

Ethnic groups can be differentiated by identifying unique characteristics that remain embedded at archaeological sites. This is a broad area of research that requires interdisciplinary attention. While many such studies have been based on the analysis of material evidence, particularly of architectural and ceramic properties, other studies (especially from later periods) are based on historical documentation. Increasingly, food remains of ancient populations (a research area known as archaeozoology) are also being utilized to assist in studying cultural and ethnic characteristics.

A great deal of information can be extracted from animal remains, such as herd management, as well as meat consumption and animal-slaughter patterns introduced in different periods. The cultural information about ancient populations that these elements reveal is due to the uniqueness with which different human groups select and prepare their food. These choices may be expressed by taboos related to eating animal meat (for example, the prohibition against the consumption of pork for Jews and Muslims), changes in slaughtering methods and/or feeding preferences or avoidance of certain skeletal parts.

This study is another step in the effort to become better acquainted with the ethnic and cultural identity of the inhabitants of Judea in the Late Second Temple period, as reflected in the remains of animal bones found at archaeological sites. It will emphasize two important sites from this period. One is a Jerusalem city dump discovered on the eastern slope of the City of David on the west bank of the Kidron Valley, which served as the great temple city's main garbage disposal site (Bar Oz *et al*. 2007; Bouchnick 2010; Reich and Shukron 2003). The other is on the Qumran plateau, at a site that has been extensively discussed in the framework of Dead Sea Scrolls research, where refuse containing animal bones, ash and fragments of pots revealed the as-yet unparalleled practice of burying refuse in jars (Bouchnick 2008, 2013) (Fig. 16.1). Previous studies discussed unique characteristics, revealed during bone assemblage analysis, which aid in determining the ethnic identity of the inhabitants of the sites. These characteristics are reflected in the absence of prohibited animals, especially the absence (or near absence) of pig bones, and the presence of kosher fish (Jerusalem: Bouchnick *et al*. 2004, 2007, 2009; Qumran: Bouchnick 2008, 2013).

These sites were active during a significant period in Jewish religious life, the time during which, in the shadow of the destruction of the Second Temple, kosher slaughter developed and early Jewish law was first codified in the Mishnah. This study therefore emphasizes slaughtering marks found on the bones of common livestock – goat (*Capra hircus*), sheep (*Ovis aries*) and cattle (*Bos taurus*) – and analyzes the frequency and composition of the cut marks found in the context of halakhic texts from the Mishnah (approximately 200 AD), the Talmud (approximately 500 AD) and primary halakhic authorities (from 1000 AD onward, Maimonides, for example) documenting the tradition of slaughtering and meat preparation among the Jews.

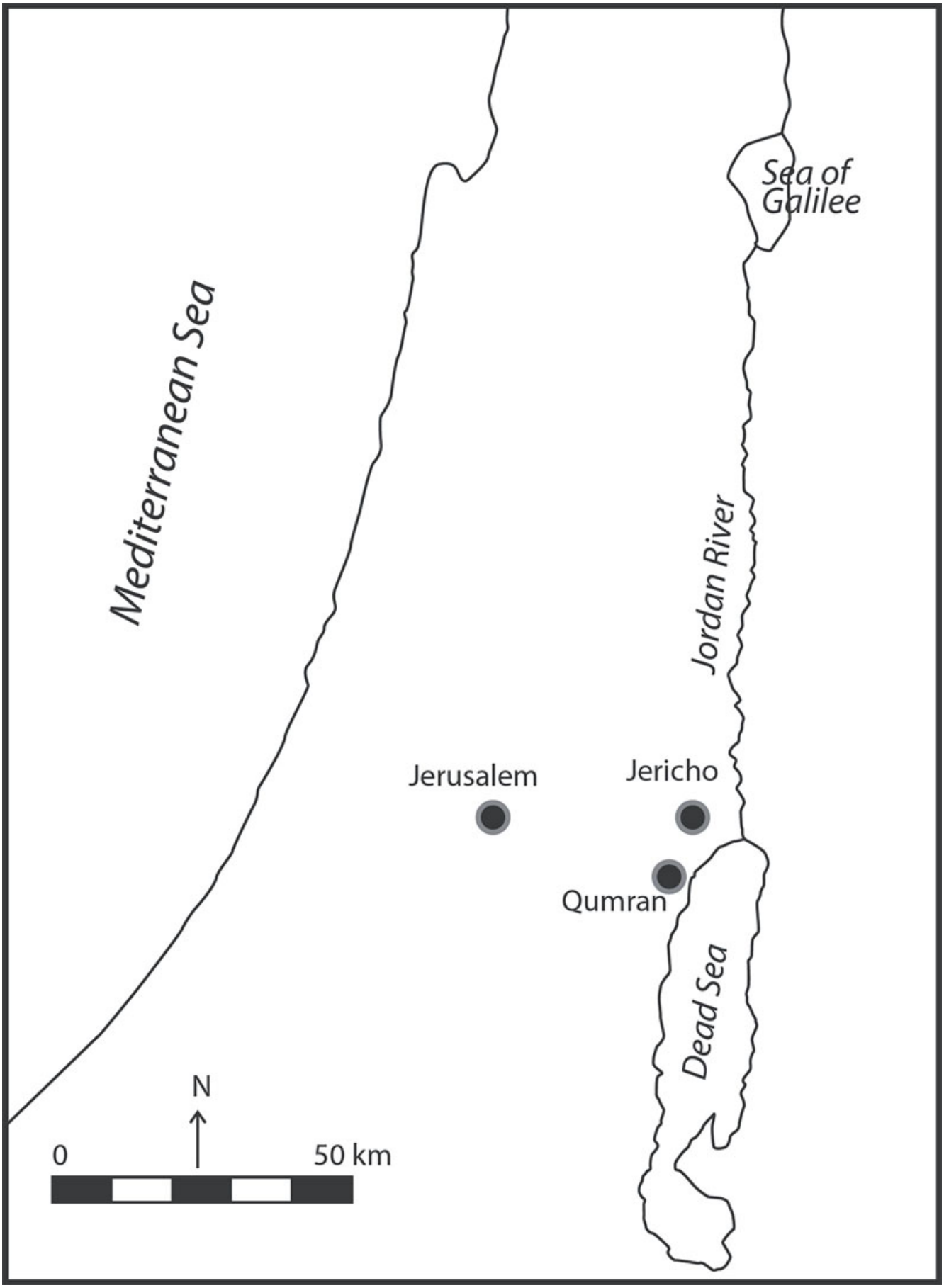

Fig. 16.1. Map showing the locations of Jerusalem and Qumran.

According to Judaism, food entering the believer's body is a significant factor influencing the nature of that individual. Therefore meat consumption and preparation processes are rigorously regulated. Great importance is given to the process of slaughter and dismemberment and to preparation for consumption of kosher ("pure") animals only. Only a limited number of animal species are permitted for consumption. Among these are some farm animals and a few species of wild animals, poultry, fish and grasshoppers.

Characteristics of certain animals that permit or prohibit them as food are specified in two biblical passages, Leviticus 11 and Deuteronomy 14. For wild and farm animals, as well as fish, some general rules are set and only certain animals within each category may be eaten. These biblical passages contain a list of prohibited birds and another list of permitted grasshoppers.

After selecting an animal, it must be killed before eating because of the prohibition against consuming the organs of live animals (Genesis 9:4 as interpreted in the Babylonian Talmud, Sanhedrin 59a). Fish do not require kosher slaughter, but they too must be killed before being eaten. As noted, the laws governing kosher slaughter were set during the time of the Mishnah and the Talmud and were based on biblical sources; however, they had to be adapted to the needs of the period in accordance with technological developments.

Stages of ritual slaughter

This slaughtering method is based on two verses in Deuteronomy (12:21–12:22), which indicate only that the rules of kosher slaughter were given to Moses. However, details regarding the slaughter of animals are listed in the Mishnah and Talmud. These rules apply to animals and birds; as noted, there are no restrictions or guidelines on how to slaughter fish, nor are there for grasshoppers.

According to the biblical commandments, only kosher animals may be slaughtered and only if they are healthy and the act is carried out according to Jewish law and belief that eating forbidden food defiles the soul (some find the basis for this approach in Ezekiel 4:14).

The main stages of slaughtering of animals and birds include slitting the throat from front to rear. In this process the trachea and esophagus (called in Hebrew the *simanim* – "signs") must be cut with a knife that is sharp, smooth and free of any flaw. This must be done while maintaining the five laws of ritual slaughter, as prescribed in the Talmud: "Rab Judah stated in the name of Samuel: One may not eat of the slaughtering of any butcher who does not know the rules of shechitah. And these are the rules of shechitah: pausing, pressing, thrusting, deflecting, and tearing" (Babylonian Talmud, Chullin 9a).

"Pausing" refers to the requirement that slaughter be continuous. "Pressing" means that the cut must be made by moving the knife back and forth and not by pressing it to the throat. "Thrusting" involves making the incision from front to rear, with the knife visible at all times. "Deflecting" is the prohibition against slaughter above or below the animal's neck while tilting the knife blade. "Tearing" means that the trachea and esophagus must be cut without being torn away from the jaw due to a defective knife. In addition, cutting or even contact with the cervical vertebrae is prohibited during slaughtering; some rabbinic authorities cite faulty neck-bone cuts as a reason to reject the animal for consumption.

Failure to follow any of these rules renders an animal *nevela, i.e*. a kosher animal, but not killed in accordance with Jewish law and therefore forbidden for consumption.

After slaughtering, the slaughterer needs to check whether the trachea and esophagus were cut as required, and therefore, he must be familiar with all the details of slaughtering and inspection. Halachic discussions in the Talmud and thereafter show that it gradually became more common to make use of professional slaughterers and inspectors rather than slaughtering animals privately at home; eventually slaughter was performed solely by a growing cadre of experienced and knowledgeable individuals. Evidence of the rule that meat must be purchased solely from recognized slaughterers only appears in later sources, such as Maimonides' Mishneh Torah. "We do not purchase meat from every butcher, [only from] an upright man who has established a reputation for observance. If he slaughters meat himself and sells it, his word is accepted" (Mishneh Torah, Ma'achalot Assurot 8, 7).

Slaughtering and inspection were usually followed by a unique aspect of Jewish practice – *nikur* – the removal of the sciatic nerve, which derives from Genesis 32:32: "Therefore the children of Israel eat not of the sinew which shrank, which is upon the hollow of the thigh, unto this day: because he touched the hollow of Jacob's thigh in the sinew that shrank".

The fatty coverings of certain parts of the animal were also forbidden (Leviticus 7:22–7:26). After slaughtering, following the draining of the blood, the slaughterer skinned the animal and hung it by its hind legs. The stomach would then be cut lengthwise and the internal organs removed.

The difficulty of properly removing the sciatic nerve led to the custom in recent generations of selling the hind legs, which include the sciatic nerve, to non-Jews. Removal of the sciatic nerve leaves marks on the hind limb bones, unlike other *nikur* operations, including the reduction of the internal organs' fat, and just as no marks were allowed to be made on the neck vertebrae, so too, cut marks on the hind bones invalidated the animal for consumption.

A number of researchers have examined various issues related to cut marks that remain on animal bones after kosher Jewish slaughter. Cope (2004) tried to identify unique features on ancient bones according to early Jewish slaughter, focusing on the abhorrence of blood, while others sought additional characteristics of significant Jewish imprint on animal bones at archaeological sites (Bouchnick *et al*. 2007).

Greenfield, who specializes in identifying the type of knife used for slaughter and filleting animals in antiquity, checked, together with this author, the relationship between halachic law and a variety of cut marks discovered on bones from the ancient Jerusalem city dump (Greenfield and Bouchnick 2010).

The present initial study compares Jewish religious sources and Judean slaughtering customs of the late Second Temple period by examining animal bones derived from various sites, and in analyzing the findings, it seeks evidence of ritual slaughter and the removal of the sciatic nerve. In addition, an attempt was made to identify professional slaughtering in Judea, although this requirement came into effect only in Talmudic times. Such evidence may emerge if anatomical similarity of cut marks can be identified.

Methods

Animal bones examined in this study were collected manually and systematically. At Qumran this was done after sifting of selected excavation units, while the bones from the Kidron dump in Jerusalem were collected by wet sieving (5 mm sieve). During the archaeozoological analysis, all bone fragments, including identifiable skull parts and teeth, were reviewed. Long bone fragments whose length

exceeded four centimeters and whose species could not be clearly identified were divided into two groups by size – large (Bos-size) and medium (caprine-size).

Identification and documentation of animal bones included several key steps:

1. Identification: classification of skeletal part discovered according to species. Skeletal parts of animals with similar skeleton structure and body size were identified by morphological indices in indicative bones of goats and sheep (Boessneck 1969; Zeder and Lapham 2010), fowl, pigeons and partridge (Cohen and Serjeantson 1996).
2. Taphonomy: Emphasis was placed on examination of bone surfaces in order to find taphonomic indications, which can help identify destruction processes caused by natural and human activity. The presentation of evidence of human activity is a key part of the present study. This evidence appears in the form of cut marks that indicate slaughter and dissection (Binford 1981), as well as burn marks indicating roasting or cooking (Stiner *et al*. 1995).

   It is important to note that cut marks detected on the surface of animal bones, which are evidence of slaughtering and butchering, are not scattered randomly, but rather their position on the animal's body is indicative of various actions. Binford's study (1981) clarifies that besides signs of slaughtering (decapitation), evidence for three major actions could be identified by the cut marks on the animal bones: skinning, dismembering and filleting.

   In Greenfield's detailed description of butchering (2000, 2004), he distinguished between skeletal dissection (dismemberment), for instance, separating the skull from the spine, and, for small units, skeletal segmentation (disarticulation); for instance, separating upper and lower limbs. Greenfield also separated unique cut marks (select cuts) of cutlets containing bone fragments, including the center of the femur and tibia. In this study cut marks are documented in terms of their spatial location on the animal's skeleton, because of the link between the location of the incision on the animal's body and its purpose during consumption.

   In addition, this study focused on evidence visible on bone surfaces that the animal was hung after slaughter (Cope 2004), as well as signs on the pelvic bones and hind limbs that may indicate the removal of the sciatic nerve. Sawn or smoothed bone surfaces were recorded as indications of the tools used in the preparation process.
3. Examination of mortality profiles of major livestock (caprine and cattle): This was done in two ways: according to the state of bone fusion (Silver 1969) and to tooth eruption and wear sequences (Grant 1982; Payne 1973).
4. Comprehensive analysis of bone assemblages: Examination of animal groups was based on three common archaeozoological research methods (Lyman 2010; Reitz and Wing 2008): general number of identified skeleton parts (NISP=Number of Identified Specimens), minimum number of individuals for each species (MNI=Minimum Number of Individuals) and the relative frequency of different skeletal parts of all the body bones (MAU=Minimum Animal Units).
5. Pathology: Study of diseases and injuries in the animal bones collected in the study. Bone studies of farm-raised animals can further our understanding of the lifestyle of humans and their farm animals. Poor nutrition, hard work and various diseases leave their marks on bones and help identify the living conditions of livestock. Evidence of the treatment of fractures and other bone injuries may also indicate capabilities of the ancient inhabitants (for an initial review of pathological variety found in different animal bone assemblages in Israel see Baker and Brothwell

1980).

Results

Slaughtering patterns and meat consumption as revealed in animal bone assemblages from Judea of the late Second Temple period indicate strict observance of the laws regarding the slaughter and consumption of kosher animals by most of the inhabitants of Judea.

In terms of species frequency, the examination of the bone assemblages revealed a high frequency of caprine bones (Jerusalem: 64%; Qumran: 73%) and cattle (Jerusalem: 12%; Qumran: 21%). Meager remains of wild herbivores were also found at both sites – a small quantity of gazelle and fallow deer bones were discovered in Jerusalem and a slightly higher quantity of gazelle remains at Qumran (Table 16.1, Fig. 16.2). While mammalian bones discovered at Qumran included only kosher animal bones, a small number of non-kosher bones were found in Jerusalem. Among these were small quantities of bones from small predators, which seem to have dug into the dump seeking food.

Table 16.1. Frequencies of species by assemblages.

	Jerusalem Kidron dump		*Qumran plateau*	
	NISP	*% NISP*	*NISP*	*% NISP*
Ovis aries	196	3.0	120	2.0
Capra hircus	97	2.0	109	2.0
Caprine	3,787	64.0	4,580	73.0
Cattle	717	12.0	1,297	21.0
Sus scrofa	3	0.0	0	0.0
Equus assinus	4	0.0	0	0.0
Herbivorous	23	0.0	104	2.0
Carnivore	35	1.0	0	0.0
Rodent	17	0.0	5	0.0
Gallus domesticus	319	5.0	16	0.0
Columba livia	111	2.0	1	0.0
Other aves	60	1.0	7	0.0
Pisces	268	5.0	1	0.0
Mollusca	138	2.0	21	0.0
Total	5,880		6,245	

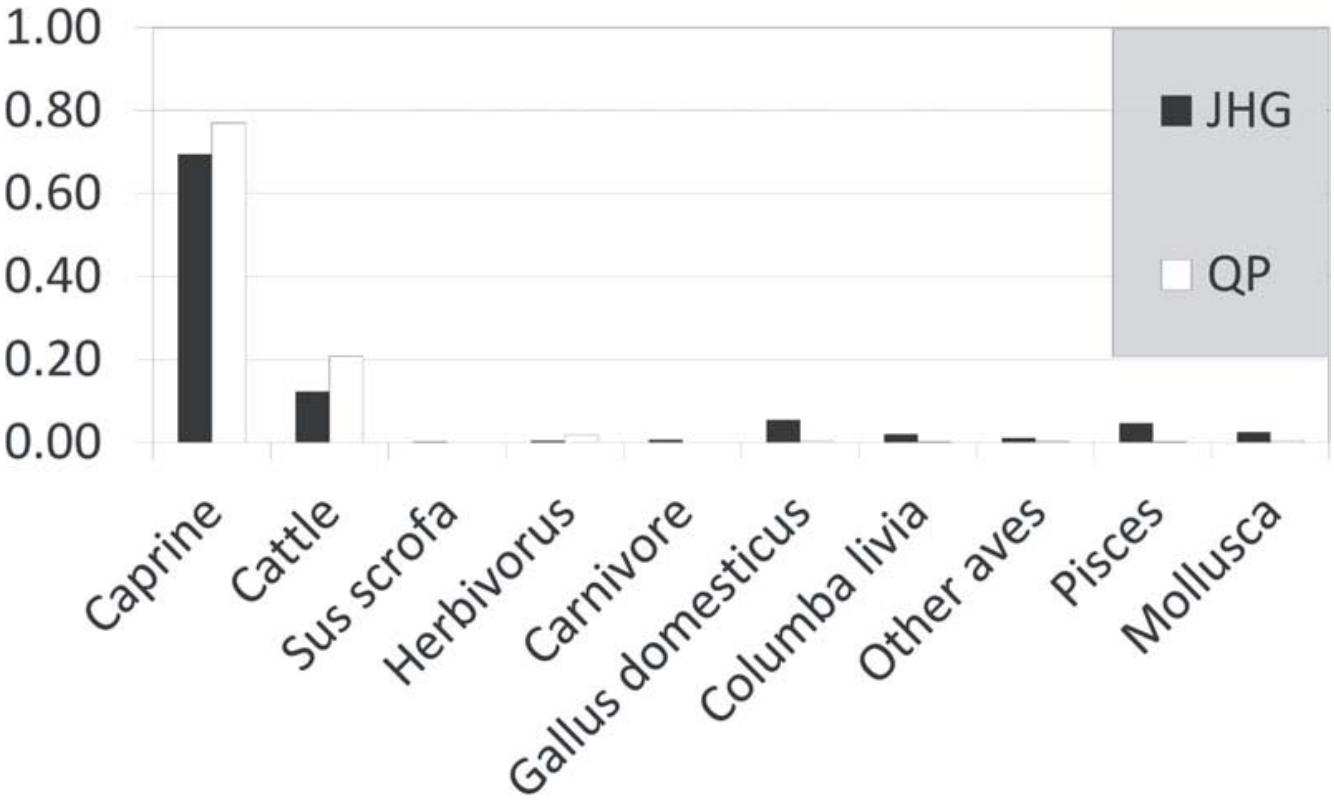

Fig. 16.2. Frequencies of species by assemblages (% NISP).

The variety of bird species identified in the bone assemblages presents a similar picture. A number of bones from kosher poultry were found at Qumran and Jerusalem, with the poultry assemblage at Qumran very small. The most common bird at both sites was fowl, but in Jerusalem, fowl constituted more than 5% of the assemblage, while at Qumran its presence was negligible. Remains of pigeons and songbirds were found at both sites. Seagull bones – whose presence was probably due to the propensity of this bird to feed at human refuse sites (Kihlman and Larsson 1974) – were discovered in Jerusalem only (Table 16.1, Fig. 16.3).

Another particularly striking component in the diet of ancient Jerusalemites in the period under discussion was kosher fish. The fish bones discovered consisted only of permitted species according to Jewish law and included a clear preference for Mediterranean over freshwater fish. The most common remains were Mugilidae (Mullet, 22%), Sciaenidae (Drum, 12%), Sparidae (Bream, 11%) and Carangidae (Jack, 10%). The freshwater fish are represented by Cyprinidae (Carp, 19%) and Cichlidae (St. Peter fish, 8%) from the Sea of Galilee, the Jordan River and Israel's coastal streams (Fig. 16.4). In Qumran, on the other hand one single, unidentified fish bone was discovered (Bar-Oz *et al*. 2007; Bouchnick *et al*. 2006, 2007, 2009).

A negligible number of swine bones appeared in the assemblages, compared to the high incidence of such bones in Early Roman sites. A clear example of the latter is the animal bone assemblage from the Jerusalem Eastern Cardo. This site presents a very different picture of the variety of livestock consumed, with swine remains making up more than 60% and caprine remains less than 20% (Table 16.2) (Horwitz in press).

Mortality profile

The mortality profile (based on dental examination) of caprine and cattle indicates that most Jerusalemites consumed animals slaughtered at a young age. A high proportion of caprines (71%) and cattle (50%) were slaughtered before they reached two years of age (Table 16.3). A different picture emerges at Qumran where only a third of the caprines (34%) flock and a similar percentage of cattle (based on bone fusion; Table 14.4) ended their life before the age of two. The high incidence of juveniles suggests that Jerusalem was a major consumer center in Judea to which young caprines and cattle were imported as a meat source. The prevalence of young individuals is particularly striking in comparison to rural settlements (Bouchnick *et al*. 2006), and even when compared to the Qumran desert community (Bouchnick 2008, 2013).

Bone assemblages from both Jerusalem and Qumran include nearly no bones with pathology (Jerusalem: cattle, 0.4%, caprine, 0.3%; Qumran: cattle and caprine 0.2%; and negligible proportion of gazelle and fowl bones from Qumran and Jerusalem respectively), indicating that no animals were slaughtered due to chronic disease (Table 16.5). This may be evidence that the inhabitants followed the Jewish law of slaughtering healthy animals only. Exceptions are the remains of caprine and cattle phalanges, which bore signs of condensation typical of fatty deposits on these bones (Fig. 16.5). These signs indicate that the animals in question suffered from excessive fattening at an early age (O'Connor 2000). However, it may be assumed that when these animals were slaughtered as adults they exhibited no external signs that would have disqualified them from consumption in terms of Jewish law. Minor pathological evidence of disease appearing in the bones of the adult animals examined support the assumption that edible livestock in Jerusalem was utilized primarily as meat and was not extensively used for secondary purposes such as labor, milk and wool.

Table 16.2. Frequencies of species in the Jerusalem Eastern Cardo assemblage.

	Jerusalem Eastern Cardo	
	NISP	*% NISP*
Ovis aries	11	2
Capra hircus	9	2
Caprine	65	13
Cattle	15	3
Sus scrofa	304	62
Equus assinus	9	2
Herbivorous	0	0
Carnivore	0	0
Rodent	0	0
Gallus domesticus	35	7
Columba livia	0	0
Other aves	22	5
Pisces	3	1
Mollusca	0	0
Total	494	

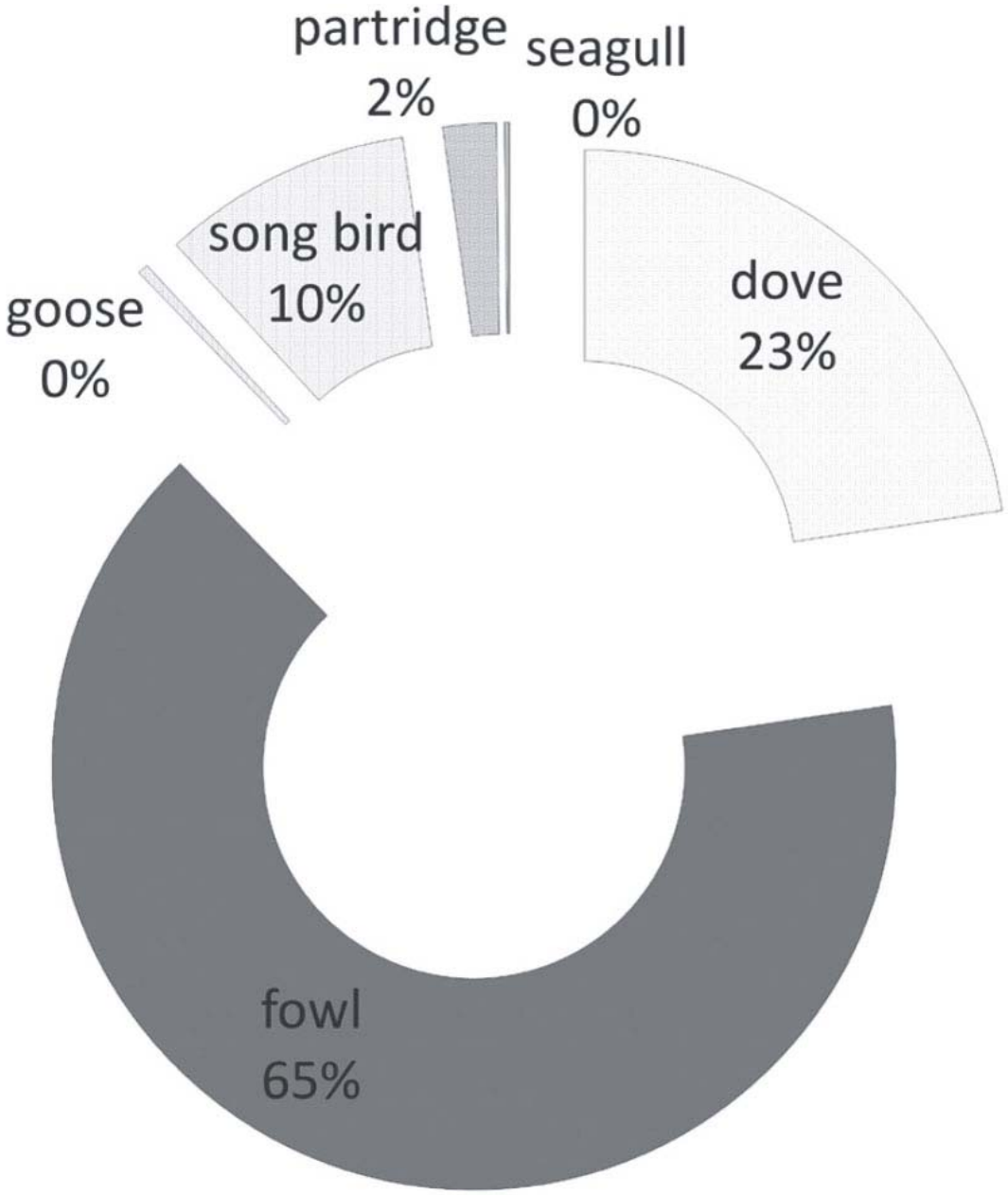

Fig. 16.3. Frequencies of bird species (and taxon) in the Jerusalem assemblage (% NISP).

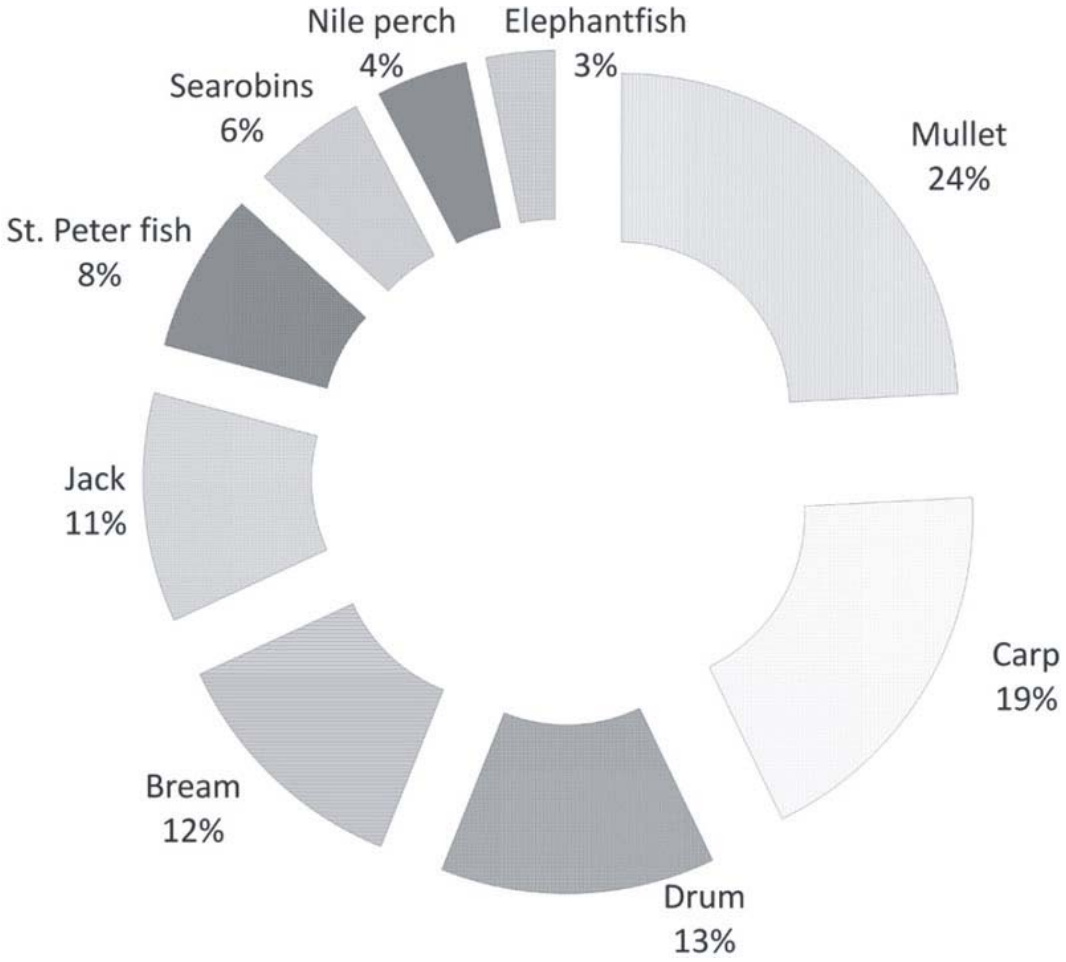

Fig. 16.4. Frequencies of fish species (and taxon) in the Jerusalem assemblage (% NISP).

Table 16.3. Summary of caprine and cattle age ratios based on tooth eruption from the Jerusalem assemblage.

	Caprine		*Cattle*	
	NISP	*% NISP*	*NISP*	*% NISP*
0–12	18	53.0	4	50.0
13–24	6	18.0	3	38.0
25–36	5	14.0	0	0.0
37–48	4	12.0	1	12.0
48+	1	3.0	0	0.0
Total	34		8	

*Table 16.4. Summary of caprine (based on tooth eruption) and cattle (based on bone fusion) age ratios from the Qumran assemblage. * = ?*

	Caprine		*Cattle	
	NISP	% NISP	NISP	% NISP
0–12	5	24.0	10	13.0
13–24	2	10.0	15	20.0
25–36	4	19.0	16	22.0
37–48	8	38.0	34	45.0
48+	2	10.0	0	0.0
Total	21		75	

Table 16.5. Pathology frequency of animals from Jerusalem and Qumran assemblages.

		Jerusalem Kidron Dump	Qumran plateau
Caprine	n	11	10
	%	0.3	0.2
	Sum	4,080	4,809
Cattle	n	3	2
	%	0.4	0.2
	Sum	717	1,297
Gazella	n	–	1
	%	–	1.0
	Sum	18	104
Fowl	n	2	–
	%	0.6	–
	Sum	319	16

Fig. 16.5. Caprine phalanges with pathology (circled) from the Jerusalem assemblage.

Bone assemblages from Jerusalem and Qumran contained a substantial number of cut marks (n=357, 8%; n=209, 3% respectively) showing slaughtering and meat preparation for consumption. Cut-mark frequency detailed in Table 16.6 revealed that cattle bones had more cut marks than those of caprines, both in Jerusalem (cattle, 10%; caprine, 7%) and Qumran (cattle, 4%; caprine, 3%). Their composition indicates that the majority of cut marks were made during the dismembering of the caprines (Jerusalem, 40%; Qumran, 37%) and cattle (Jerusalem, 23%; Qumran, 44%). An exception is the high rate of filleting discovered on Jerusalem cattle bones (28%). Additional cut marks were created while slaughtering and hanging the animals (although cut marks from hanging were rare; in Jerusalem: caprine, 1%; cattle, 1%; at Qumran: caprine, 3%, cattle, none) and during skinning.

The rarity of marks on the neck bones of edible animals may indicate kosher Jewish slaughter, in which, as noted, the trachea and esophagus were to be severed without contact between the cleaver and the neck bones.

Discussion

This study attempted to cross-reference information gleaned from late Second Temple-period archaeological evidence and Jewish religious texts, with the aim of determining whether the examination of animal bones from Jerusalem's Kidron dump and animal bones buried in pottery vessels at Qumran can reveal that Jewish ritual slaughter as accepted today was customary at that time. The study has not yet yielded conclusive results, but it opens a path to more extensive field research.

The bone assemblages indicated that meat eaten in Jerusalem and Qumran derived from kosher animals, particularly caprines and cattle. However, the diet of Jerusalem residents was rich and varied and also included some herbivores and poultry, mainly chicken and pigeon as well as a variety of fish from the Mediterranean Sea and fresh-water sources. Qumran's inhabitants, in addition to sheep and cattle, consumed hunted venison but no poultry.

Table 16.6. Cut-mark frequency of caprines and cattle from Jerusalem and Qumran assemblages.

			slaughter & hanging	*skinning*	*dismemberment*	*filleting*	*sawing*	*Unknown*	*Sum*
Caprine	JKD	n	3	27	112	88	20	33	283
		%	1	10	40	31	7	12	
	Qumran	n	5	12	58	23	9	49	156
		%	3	8	37	15	6	31	
Cattle	JKD	n	1	14	17	21	1	20	74
		%	1	19	23	28	1	27	
	Qumran	n	0	1	24	13	3	13	54
		n	0	2	44	24	6	24	

Several studies (Bouchnick *et al*. 2007; Bunimovitz and Lederman 2009; Greenfield and Bouchnick 2010; Hesse 1986, 1990, 1995; Lev-Tov 2000) indicate that the frequency of non-kosher remains, primarily pig (but also rabbit, donkey, horse, *etc*.) in animal assemblages has great importance in determining the ethnicity of bone assemblages. The negligible proportion of swine bones from the Jerusalem city dump and the lack of swine from the Qumran assemblage allow the ethnic identity of the bone assemblages from these sites to be identified as Jewish.

While similarity in animal species was discovered at both sites, significant differences were found in the mortality profile of cattle and caprines at the two sites in this study; in fact, the results indicate a mirror image. In Jerusalem most of the animals were slaughtered before 24 months of age, when they would be sold for meat in the city market – a phenomenon characteristic of large consumer centers (Zeder 1988) that was highlighted in Jerusalem, which was also a large religious ritual center during this period. However at Qumran much of the livestock was slaughtered as adults (after 24 months of age). This is a meat-consumption pattern more appropriate for productive communities.

Various studies (Redding 1981; Stein 1988; Zeder 1988; Marom and Bar-Oz 2009) indicate the utilization of secondary products of livestock (wool and milk among sheep and goats; milk and labor among cattle) as a main factor influencing the finding of a high frequency of animals slaughtered as adults at rural-productive sites. The low frequency of individuals slaughtered at a young age also meant that these animals survived to reproduce, thus ensuring the future of the flock.

Significantly, the harsh desert climate at Qumran, located in the Judean desert near the Dead Sea, did not allow caprine and cattle flocks to grow and flourish near the site. Various studies (Bar-Nathan 2002, 2006; Gunneweg and Balla 2001, 2005) have identified extensive trade relations between Jericho and Qumran and concluded that Qumran's inhabitants may have consumed livestock acquired in the markets of Jericho.

However, Qumran's livestock mortality profile, with its high frequency of adult animals, does not have the characteristics of animals purchased at a market. Perhaps the profile is evidence of trade relations with shepherds who pastured their flocks on the edge of the desert in winter and spring before returning to their homes in the Judean Mountains, with such management allowing the herd to be maintained and hence the sale of few young individuals for meat.

The age of the animals at death as revealed by the bones can be put to good use as supporting

evidence for understanding the lifestyle of the inhabitants of Qumran in the late Second Temple period. The high frequency of adult animals could be evidence of abstemiousness or austerity imposed on Qumran residents to make use of livestock throughout the animals' adult life, until they left the labor market and became a meat source.

The age of livestock at death is significant in that it indicates the extent of the observance of Jewish law requiring the consumption of only healthy kosher animals, and those not approaching their time of death (Babylonian Talmud, Chullin 37a–b). Such observance is also reflected in the lack of evidence of disease on most of the bones examined.

Cut marks on the bones and especially their distribution at fixed anatomical locations across various parts of the skeleton and on the edge of long bones may indicate that slaughtering and dissection at both Jerusalem and Qumran was done by professionals for the community, rather than by private slaughterers for personal consumption. In private slaughtering, differences in the dispersion of cut marks can be seen on the animal skeleton.

Further study of meat consumption patterns of late Second Temple Jewish sites have been undertaken by Cope at sites in northern Israel (2004). In her work, Cope sought early evidence of kosher practices at Gamla and Yodefat expressed by early slaughtering and dismemberment practices. Greenfield and Bouchnick (2010) raised initial ideas to compare Jewish religious texts with Jerusalem animal bones from the late Second Temple period, to draw tentative parallels between Jewish butchery laws and animal-bone finds.

In the present study isolated evidence of slaughtering by slitting the animal's throat was found, for example on the neck vertebrae of caprines from Jerusalem (Fig. 16.6) and from Qumran (Fig. 16.7). This observation may be important as evidence, albeit scant, for slaughtering without damaging the neck bones, a sign of kosher practices. It may indicate that in both Jerusalem and Qumran, the inhabitants refrained from severing the spine, perhaps in fulfillment of Jewish law, which permitted cutting only the soft tissue of the neck (Greenfield and Bouchnick 2010; Levinger 1984).

Even from the few cut marks discovered and studied, it may be deduced that slaughter practices in Jerusalem and Qumran differed from Roman practices at that time, which involved decapitating the animal (Fig. 16.8). However, indistinct cut marks on pelvic bones notwithstanding; there were no clear signs of the removal of the sciatic nerve. Nevertheless, this may be due to the small size of the samples studied so far.

In summary, the composition of the animal assemblages discovered, particularly the negligible to total absence of non-kosher animals, are clear and explicit markers for the ethnic identification of the inhabitants of Jerusalem and Qumran as Jews. The lack of extensive signs of cut marks on the neck bones may be evidence for Jewish law prohibiting contact between the butcher's knife and the animal's neck, in contrast to the Roman practice at that time of decapitation. However, cut marks could not be clearly identified as evidence of sciatic nerve removal, a practice only done by Jews in preparing meat for consumption.

Further efforts will be devoted to research on the subject of *nikur*, the removal of the sciatic nerve, in an attempt to create a model for cut marks on hind limbs after such removal. Comparison of present-day religious slaughterhouses will also be undertaken in order to document methods of slaughter that can assist in the possible discovery of ancient slaughter patterns, the establishment of Jewish kosher slaughter laws and the analysis and interpretation of ancient animal assemblages.

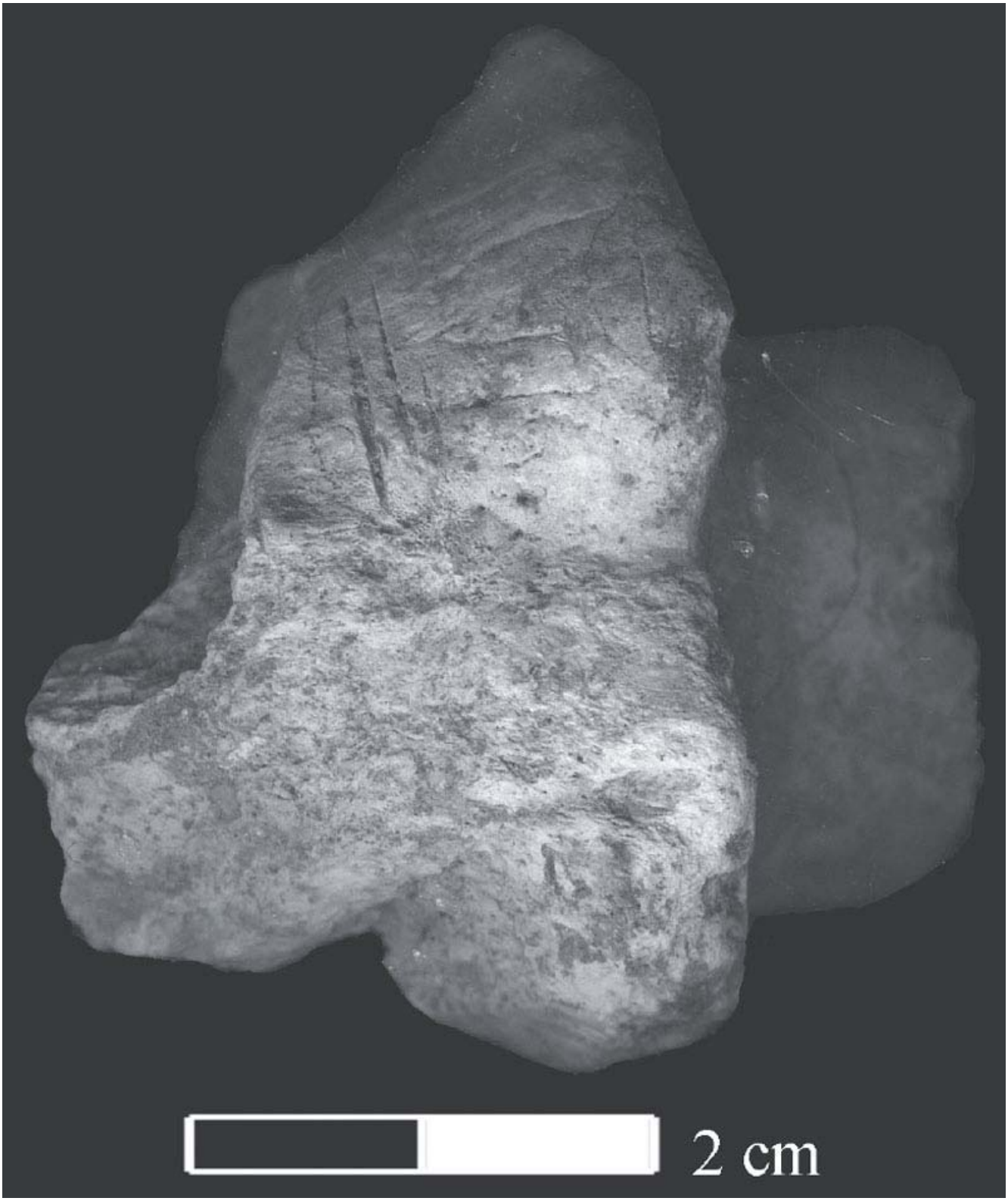

Fig. 16.6. Neck bone (axis) of sheep (*Ovis aries*) *with superficial cut marks, from the Jerusalem assemblage (from Bouchnick 2010).*

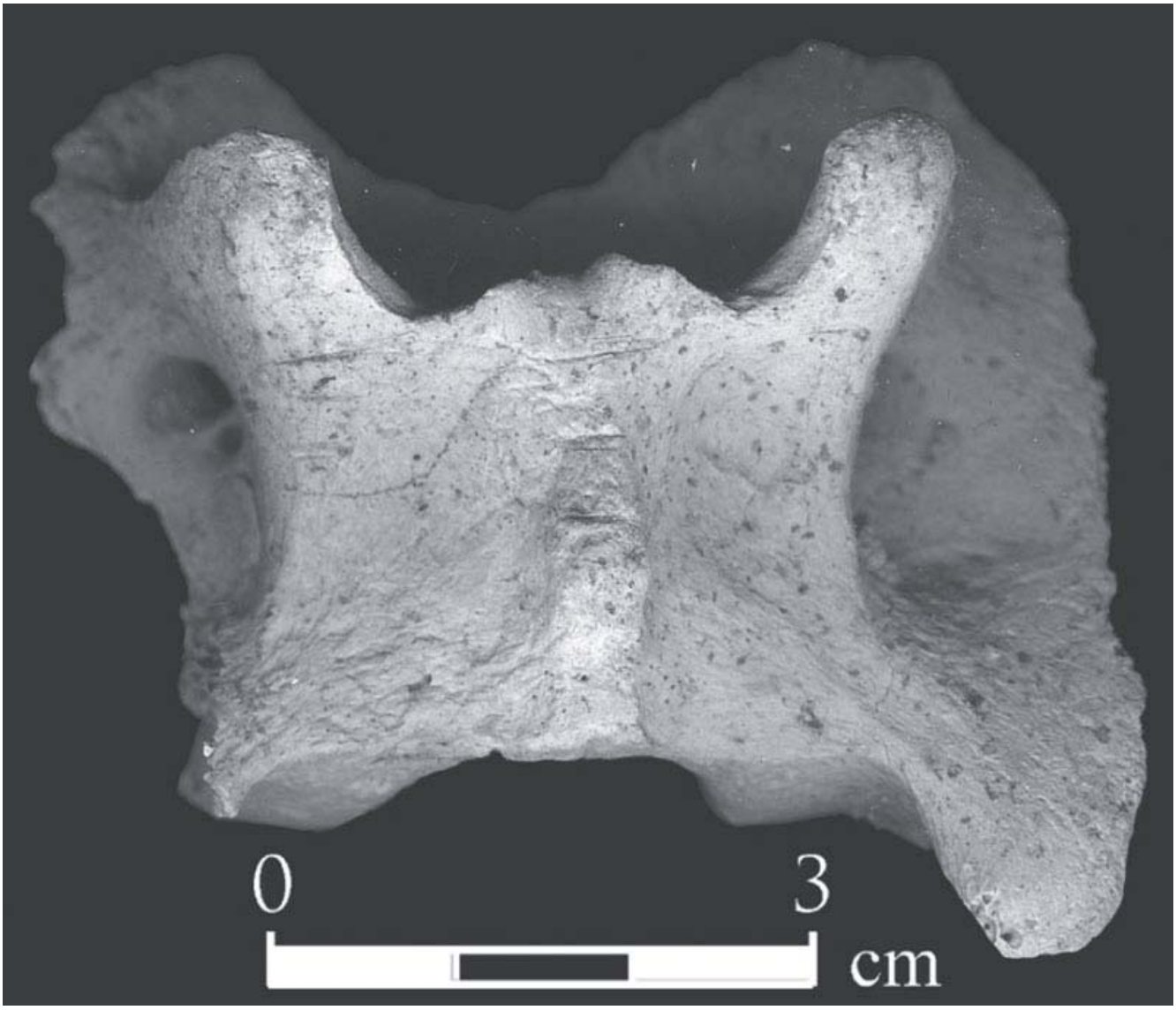

Fig. 16.7. Neck bone (atlas) of sheep (*Ovis aries*) *with superficial cut marks, from the Qumran plateau excavation (from Bouchnick 2008).*

Fig. 16.8. Neck bone (atlas) of decapitated sheep (*Ovis aries*) *from the Sha'ar-HaAmakim excavation (from Bar-Oz 2009).*

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Chapter 17

There and Back Again: A Tale of a Pilgrim Badge during the Crusader Period

Inbar Ktalav

During the twelfth century the pilgrimage phenomenon became widespread. People went on long pilgrimages to visit and worship at sites of religious significance. Pilgrims acquired a symbolic object from each site as proof of their visit. These objects would provide the owner with benefits such as safe passage, room and board, and, it was believed, some of the sacred attributes of the saint associated with the holy site. One of the most important pilgrimage destinations in the twelfth and thirteenth centuries was Santiago de Compostela in Spain, the burial place of St James. Pilgrims who visited this site bought a scallop shell to honor their visit. Such bivalves have also been discovered in a few excavations from the Crusader period in Israel. Their discovery illuminates the practice of pilgrimage, aspects of communal identity, and a complex system of fraud and power struggles associated with the act of pilgrimage.

Introduction

In some Christian societies of the medieval period the presence of saints and meeting with them was a call to action: contact through acts of worship or through imitation. In a world that was full of evil and difficulties, belief in the power of the saints was a testimony, not only to the possibility of good, but to the unseen hand of God in the world. It was believed saints transferred grace, knowledge and power from God to people, and forwarded requests, questions and demands from people to God. People told wonderful stories about saints, which provided hope and peace of mind during times of hardship. Pieces of fabric from a saint's clothing, water that had touched a saint, and the saint's blood were considered to be imbued with the saint's power and personality. Such talismans were believed to extend the sphere of influence of the saint. These remains were the means by which a saint could return to life (Kleinberg 2000: 13–14). Later on, this conceptual approach would also apply to the pilgrim badge. To simple people, a saint was mainly a source of power; the other elements in his personality were secondary for them (Kleinberg 2000: 238–239).

The burial place of a saint often became a pilgrimage site. During the eleventh century the

demographic growth, agricultural reforms and trade brought new ways of life and new ideas. The common people became thirsty for new gratifications and new liberties. One of the outcomes of this was that they filled the roads towards pilgrim sites (Kleinberg 2000: 243; Le Goff 1993: 51). The three most important destinations for medieval pilgrims were Jerusalem, Rome and Santiago de Compostela. One particular phenomenon that developed towards the end of the eleventh century was the practice of having a formal badge that pilgrims brought home as souvenirs and as testimony of the accomplished pilgrimage. A pilgrim badge was a religious token, believed to possess mystical powers, and acquired by a pilgrim at a shrine. It was worn by the pilgrim while undergoing the journey (Garcia 2005: 2). Since pilgrim badges had become indispensable evidence of a performed pilgrimage, no pilgrim would return home without first having purchased a badge. The badge worn on the return journey ensured its bearer protection from warring Christian armies and other threats of violence.

During the twelfth century the badges began to assume a religious significance of their own. The pilgrim had to take the badge to a shrine so that the saint's relics would be able to transmit their virtues to the badge (Cohen 1976: 194–195; Spencer 1998: 16–17). Every pilgrim badge was special to a particular place and to the saint or relics associated with that location (Spencer 1998: 3). After the pilgrim returned home, the badge was sometimes hung up as lucky charm in the pilgrim's home or used as a foundation deposit. Some pilgrims took the badge with them to their grave and others threw them at river crossings, especially in London (Spencer 1998: 18). The latter practice refers mostly to metal badges. Pilgrim badges were found in graves along with crosses and remains of other pilgrim equipment like the scrip and the staff (Almazán 1996: 132; Johns 1950: 162; Vallet 2008: 238–241). Due to this fact, pilgrim badges can be used as indication to pilgrimage.

Santiago de Compostela, St James the Greater and the scallop shell

It is only in the ninth century that historical sources begin to mention the discovery of St James's burial-place in Spain. Although Herwaarden (1980) claims that there is neither evidence to substantiate the belief that St James the Greater's mortal remains lie in Spain, at Santiago de Compostela, nor that he ever preached in Spain or visited that country, this location was widely believed to hold his relics. The cathedral of Santiago de Compostela became a religious center of high importance in the medieval period, and pilgrims from all parts of Europe and the British Isles flocked to Santiago de Compostela. The scallop shell along with the staff, scrip (a pilgrim's bag), hat and cloak are the most popular attributes of St James (Ashley and Deegan 2009: 15). These are the basic gear needed for long travel by foot. They were used extensively by pilgrims and eventually became symbols for pilgrimage. But what is the significance of the scallop shell and why was it chosen as one of the main attributes of St James?

According to Hohler (1957: 56) the earliest representation of a pilgrim wearing the shell (attached to his scrip) is on the west doorway of Autun cathedral in Burgundy (1130–1140 CE). The first literary evidence for the scallop being the badge of the pilgrimage to Santiago de Compostela is in the *Liber Sancti Jacobi*. The *Liber Sancti Jacobi* was a guide to pilgrimage routes to Santiago de Compostela through France and Spain, and it was part of the *Codex Calixtinus* that was compiled in the mid-twelfth century (Ashley and Deegan 2009: 13). The guide states that shells to attach to pilgrims' cloaks were on sale in the booths around the paved court north of the cathedral. It also accounts that in 1106, a knight of Apulia was cured of the goiter by the touch of a shell brought home by a pilgrim. A mystical

explanation of the badge is that the two valves of the shell symbolize the two great commandments (see below) and the markings fingers with which we perform good deeds also appear in the book. Hieronymus Münzer, a 56-year-old physician who travelled to Santiago de Compostela in the late fifteenth century comments in his personal diary about the explanation of the badge which he copied from the *Codex Calixtinus*:

> There are fish in the sea of blessed James having two shields, on each side, between which, as between two tiles, lies the fish, on the model of an oyster. The tile on top is sculptured like the fingers of a hand … Pilgrims returning from the threshold of St James place them in their caps, both in honor of the apostle, and as a sign that they have gone themselves in person on such a journey. By the two shields are signified the two precepts of charity, by which the wearer should conduct his life, one always to delight in god above all, and to love his neighbor as himself." (Krochalis 1996: 69, 80–81).

Naturally, all the reasons stated in *Codex Calixtinus* are theological and concentrate on a miracle and moral guidance. The origin of the badge is not known. In addition, another miracle story of a horseman, saved from drowning by St James who emerged from the waves covered with scallops, cannot be traced further back then the sixteenth, or possibly the fifteenth century, and was probably invented to justify an existing custom (Hohler 1957: 59). Hohler estimates that the scallops were originally brought to Santiago de Compostela as food were later on adopted as the badge of St James, for no apparent reason. Since it cannot be traced to before the twelfth century, it was probably not derived from a local pagan cult, although it is possible that later this practice was adopted and the ancient symbolism of resurrection related to this shell continued into Christianity (Eliade 1961: 132). Another ancient symbolic use of the scallop shell was as an amulet for love, a symbol of Aphrodite during the Roman and Byzantine periods (Wheeler 1957: 34–48), and as an amulet against magic spells (Almazán 1996: 132). The scallop shell formed into a pilgrim badge has been found in archaeological excavations, historical records and the visual arts in Europe since the beginning of the twelfth century, which is considered the *terminus post quem* of this phenomenon.

Pecten maximus and Pecten jacobaeus

There were the two species of scallop shells that were made into pilgrim badges of St James. *Pecten* spp. are bivalve molluscs in the family Pectinidae. Two major species are found in Europe: *Pecten maximus* and *Pecten jacobeus*. The upper (left) valve is flat and usually reddish brown while the lower (right) valve is convex and paler cream or brown in color. Both valves can be marked with spots or zigzags of red, pink or yellow. There are prominent ears occupying about half the width of the shell. There are 12–14 broad radiating ribs on the upper valve (rounded edge in *P. maximus* and angular edge in *P. jacobeus*) and concentric annual growth rings are often visible (Fig. 17.1). Both species inhabit sand or gravel substrates from low water down to 100 m depth (Beaumont and Gjedrem 2006: 2). Although there are morphological distinctions between *P. maximus* and *P. jacobaeus*, various genetic markers have failed to identify deep genetic separation. The most recent study using mtDNA suggests that the two species shared a common ancestor fairly recently in the Pleistocene (Beaumont and Gjedrem 2006: 3). *P. maximus* distribution is limited to the northeast Atlantic, from northern Norway down to north Africa (Jean *et al*. 2014: 2–3) while *P. jacobaeus* is present within the Mediterranean and the Adriatic Sea. The distributions of the two species are not thought to overlap at the entrance to

the Mediterranean (Beaumont and Gjedrem 2006: 1) (Fig. 17.2).

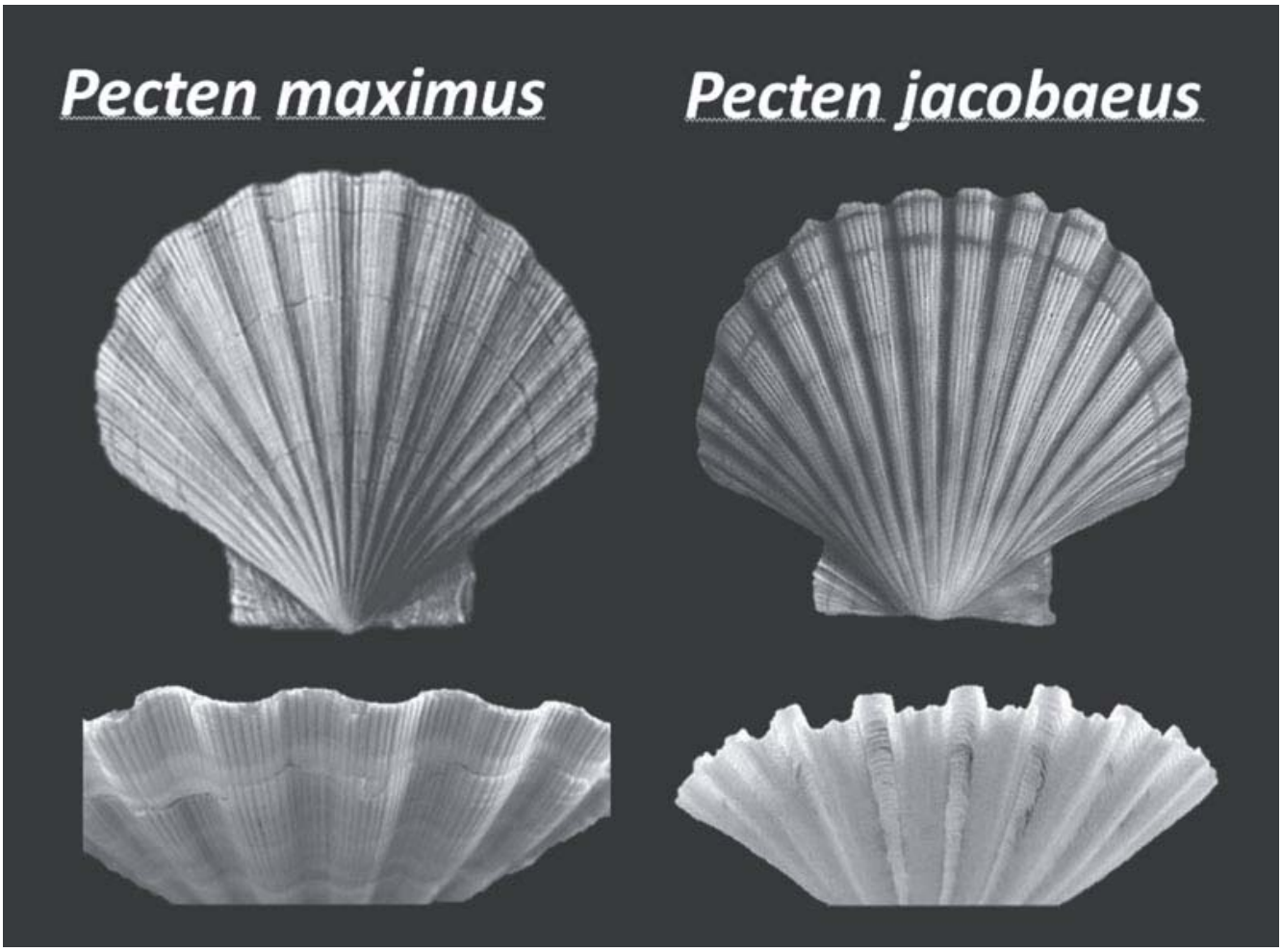

Fig. 17.1. Morphological differences between Pecten maximus *and* Pecten jacobeus.

Most of the valves found in excavations are in good condition and were taken out of the sea alive and not collected on the shore. The scallops were fished by free diving from a boat and were collected by hand (Bashford 2011). After they were harvested, the scallops were transported about 50 km to Santiago de Compostela (Holer 1957: 59).

This paper will focus on the finds of *P. jacobaeus* and *P. maximus* that were worked into pilgrim badges from seven excavations in Israel that were identified and processed by the author, in addition to published and unpublished material by others. These finds illuminate the practice of pilgrimage (mostly twelfth to thirteenth centuries CE), aspects of communal identity and a complex system of fraud and power struggles around the symbol of pilgrimage.

Results

Pilgrim badges found in the Holy Land

The malacological assemblage includes 16 specimens from eight excavations and one supervision. All salvage excavations/supervision were conducted on behalf of the Israel Antiquities Authority. Measurements and photographs were included according to the availability of the material. Following is the description of the finds according to the sites they were found in.

Fig. 17.2. Distribution map of Pecten maximus *and* Pecten jacobeus. *By Anat Regev.*

Acre

Three shells of *Pecten jacobaeus* were discovered during a salvage excavation conducted in Acre. The shells were found in surface or unclean loci (L.104, 108 and 250). Two of the shells are almost complete and the third is broken. Each of the shells has two holes in the beak of the valve, except the broken one, which has one (Fig. 17.3, 1–3). Although the shells were not found in a clear Crusader context, fragments of glazed bowls from the Crusader period were found in the excavation and Acre

was known to be a major Frankish city during the Crusader period.

Wadi Siah

One slightly broken shell of *P. jacobaeus* was discovered during excavations conducted in Wadi Siah by the late Eugenia Nitowski. The shell was found in area E, sq 5, L. 17 in the north side of a vaulted room in a thirteenth-century monastery. The valve is 52 mm long and 52 mm wide. There are two artificial holes in the beak of the valve, 14 mm apart, and each hole measures three mm in diameter. The ears of the valve are missing and it is abraded around the margins (Fig. 17.3, 4).

Tiberias

One complete shell of *P. maximus* was found during a salvage excavation at Tiberias. The shell was found in stratum two (L.108, B.1020) and was dated to the mid-twelfth to early thirteenth centuries. The valve is 79 mm long and 84 mm wide. There are two artificial holes in the beak of the valve, 10 mm apart, and each hole measures four mm in diameter. The ears of the valve are slightly broken (Fig. 17.3, 5).

Horvat Burin

A nearly complete shell of *P. jacobaeus* was found on a floor from Phase IIa (L.222) during a salvage excavation. The valve is 69 mm long and 64 mm wide, and blackened by fire. There are two artificial holes in the beak of the valve, eight mm apart measuring six mm in diameter (Fig. 17.3, 6). Another fragment of the same species was found in L. 209. Both loci are dated to the mid-twelfth to early thirteenth centuries.

Flea market, Jaffa

One broken shell of *P. jacobaeus* was found during a salvage excavation in the flea market, Jaffa. The shell was found in L.1115, B.3678, in the foundation fill of a Crusader period building (thirteenth century; Fig. 17.3, 7). Another broken shell of the same species with an artificial hole in the beak was found in L. 65, B. 567, in a fill layer containing both early Islamic pottery and thirteenth-century Crusader remains (Fig. 17.3, 8).

Kaplan excavation, Jaffa

A mostly complete shell of *P. jacobaeus* with two artificial holes in the beak was found in an older excavation by Kaplan from 1964. The findings are to be published by Burke and Peilstöcker (in prep.) in the Jaffa Cultural Heritage Project series. The valve is 57 mm long and 61 mm wide. The holes are 14 mm apart, measuring four mm in diameter. The ears of the valve are slightly broken (Fig. 17.3, 9). The shell was found in area Y, L. 602. Area Y is a Middle Bronze cemetery overlain by Persian-Hellenistic occupation, just below a surface layer associated with Islamic period disturbances.

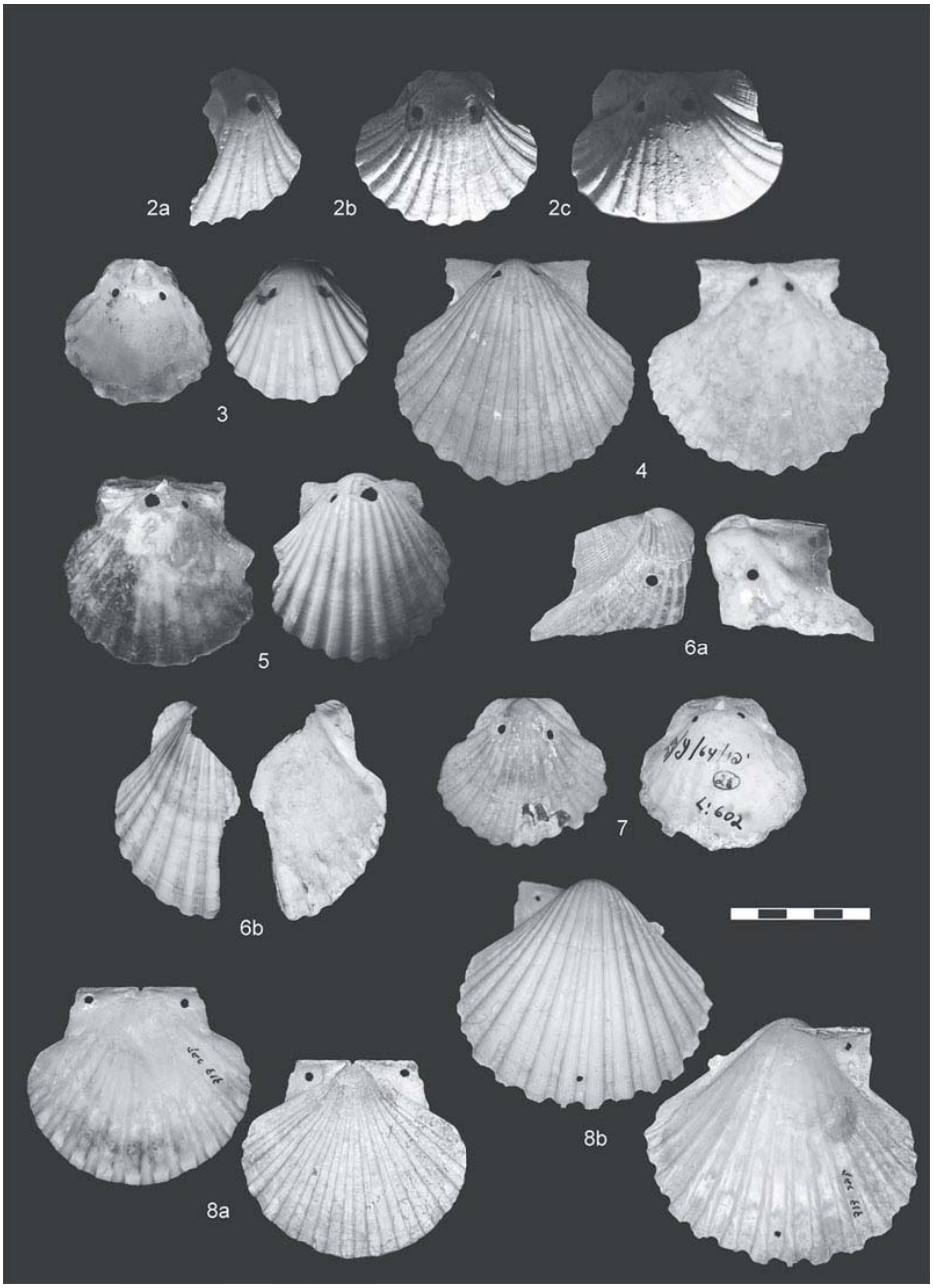

Fig. 17.3 (1–3) Pecten jacobaeus from Acre. (4) Pecten jacobaeus from Wadi Siah. (5) Pecten maximus from Tiberias. (6) Pecten jacobaeus from H. Burin. (7–8) Pecten jacobaeus from Jaffa, the flea market. (9) Pecten jacobaeus from Jaffa, Kaplan excavation. (10) Pecten jacobaeus from David's tomb. (11) Pecten maximus from David's tomb.

Citadel, Jerusalem

Johns (1950: 162) reports from his excavation at the Citadel, Jerusalem, that he found "Crusader burials with pilgrim scallop-shells, crosses and coins of the early thirteenth century". However, in plate LXII, 3 there is only one shell and it is difficult to determine from the picture whether the species is *P. jacobaeus* or *P. maximus.*

Mughrabi Ramp, Jerusalem

Three scallop shells were found during the excavation of the Mughrabi Ramp, Jerusalem. Two shells were found together in Area 500, L. 50181l, which contained Crusader-Ayyubid pottery (twelfth–

thirteenth centuries CE). The third shell was found in a mixed locus containing pottery and coins ranging from the early Roman to the Ottoman period, and also with Crusader-Ayyubid material (twelfth–thirteenth centuries CE). The shells each have two artificial holes in the beak of the valve.

David's tomb, Jerusalem

Two scallop shells were found during archaeological supervision in David's tomb by A. Nagar. The shells were found with imported ceramics dated to the thirteenth and fifteenth/sixteenth centuries. One shell is *P. jacobaeus*. It is complete with a well preserved upper (flat) valve. There are two holes in the ears of the valve. The valve is 69 mm long and 79 mm wide. The holes are 36 mm apart, measuring four mm in diameter (Fig. 17.3, 10). The other shell is a lower valve of *P. maximus*, which originally had three holes: two in the ears (one ear is missing) and one in the middle of the lower part of the back of the valve. The valve is 86 mm long and 94 mm wide. The hole in the ear is four mm in diameter and the hole in the back is three mm (Fig. 17.3, 11).

In general, most of the scallops found had two holes either in the beak of the valve or in the ears (see Fig. 17.3, 1–10), but one valve had a third hole in the lower margins of the valve (see Fig. 17.3, 11). According to Vallet (2008: 244) shells with two holes were suspended while shells with three holes were sewn onto a garment, bag or hat of a pilgrim. The location of the holes can vary, placed either in the beak (see Fig. 17.3, 1–9) or in the ears (Fig. 17.3, 10–11), the size of the shell, lower (curved) or upper valve (flat), and in graves; the location of the shell in relation to the skeleton, need further research before reaching conclusions about the typology of shell badges.

Furthermore, all the scallops reviewed above were processed the same way as the pilgrim badges that were found in pilgrim graves in Europe. These scallop shells indicated a pilgrimage to Santiago the Compostela (Almazán 1996: 132; Baier and Kühtreiber 2013: 310; Baier *et al*. 2013: 243–244; Spall and Toop 2005; Vallet 2008: 238–241). Summary of the find is listed on Table 17.1.

Table 17.1. Pilgrim badges from archaeological excavations in Israel.

Site	*No. shells*	*Species*	*Period/date*	*Context*	*Remarks*	*Fig.*	*References*
Acre	3	*Pecten jacobaeus*	surface		Right valve with 2 artificial holes in beak	2a-c	H. Abu-'Uqsa & A. Abu Hamid, pers. comm.
Wadi Siah	1	*Pecten jacobaeus*	13th C	Room in monastery	Right valve with 2 artificial holes in beak	3	Stern *et al* (in prep.)
Tiberias	1	*Pecten maximus*	mid-12th–early 13th C	Fill, plastered pool	Right valve with 2 artificial holes in beak	4	Zingboym & Hartal 2011
H. Burin	2	*Pecten jacobaeus*	12th/13th C	floor	Right valve with 2 artificial holes in beak burnt	5	Kletter & Stern 2006
Flea market, Jaffa	2	*Pecten jacobaeus*	12th/13th C	fill	Fragment of right valve with 1 artificial hole in beak	6a-b	Peilstöcker *et al*, 2006
Kaplan excavation, Jaffa	1	*Pecten jacobaeus*	Mixed layer		Right valve with 2 artificial holes in beak	7	Burke & Peilstöcker (in prep.)
Citadel, Jerusalem	1 ?more	*Pectenj acobaeus or Pecten maximus*	13th C	Crusader burials with pilgrim scallop-shells, crosses and coins of the early thirteenth century	Right valve with 2 artificial holes in beak		Johns 1950
Mughrabi Ramp, Jerusalem	3	*Pecten jacobaeus or Pecten maximus*	13th C	fill	Right valve with 2 artificial holes in beak		Barbeet al 2014, Vitto (in prep.)
David's Tomb, Jerusalem	1	*Pecten jacobaeus*	13th/ 15th–16th C		Left valve with 2 artificial holes in ears	8a	Annet Nagar, pers. comm.
	1	*Pecten maximus*			Right valve with 1 artificial hole in left ear & 1 in lower margin of valve.	8b	

All the pilgrim badges were found at Christian sites or along Christian pilgrim routes in the Holy Land (see Fig. 17.4). Most pilgrims arrived at the port of Acre, which was the starting point of their tour in the Holy Land. From there the pilgrims had to choose one of two routes. One route led to Lake Tiberias, the Jordan Valley, and from there through Samaria and Judea to Jerusalem. The other way led south from Acre along the coast and from there inland towards Jerusalem (Grabois 1986: 45–48; Prawer 1975: 217–227). Scallop shells were found on both routes. According to Prawer (1986a: 31; 1986b: 66,76), Jewish pilgrims used other routes, mostly in Muslim territory. Based on this information, we can associate the pilgrim badges that were found in the Holy Land to Christian pilgrims, who had made a previous pilgrimage to Santiago de Compostela.

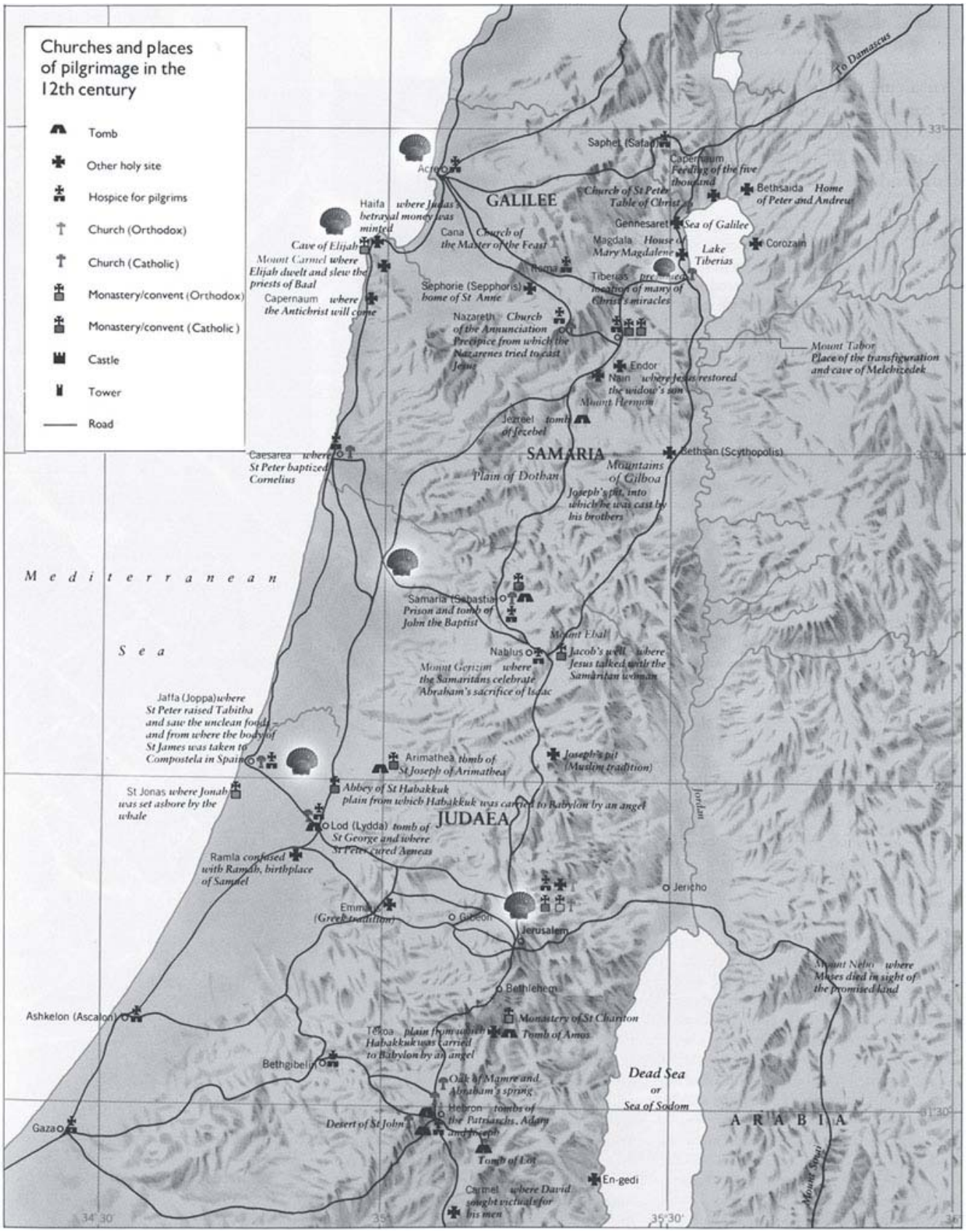
Churches and places of pilgrimage in the 12th century
Tomb
Other holy site
Hospice for pilgrims
Church (Orthodox)
Church (Catholic)
Monastery/convent (Orthodox)
Monastery/convent (Catholic)
Castle
Tower
Road
GALILEE
SAMARIA
JUDAEA
ARABIA
Mediterranean Sea
Dead Sea or Sea of Sodom
Jordan
To Damascus
Saphet (Safad)
Acre
Haifa where Judas's betrayal money was minted
Cave of Elijah
Mount Carmel where Elijah dwelt and slew the priests of Baal
Capernaum where the Antichrist will come
Cana Church of the Master of the Feast
Capernaum Feeding of the five thousand
Church of St Peter Table of Christ
Bethsaida Home of Peter and Andrew
Gennesaret
Sea of Galilee
Magdala House of Mary Magdalene
Lake Tiberias
Corozain
Roma
Tiberias presumed location of many of Christ's miracles
Sephorie (Sepphoris) home of St Anne
Nazareth Church of the Annunciation Precipice from which the Nazarenes tried to cast Jesus
Mount Tabor Place of the transfiguration and cave of Melchizedek
Endor
Nain where Jesus restored the widow's son
Mount Hermon
Jezreel tomb of Jezebel
Caesarea where St Peter baptized Cornelius
Plain of Dothan
Mountains of Gilboa
Joseph's pit, into which he was cast by his brothers
Bethsan (Scythopolis)
Samaria (Sebastia) Prison and tomb of John the Baptist
Mount Ebal
Nablus
Jacob's well where Jesus talked with the Samaritan woman
Mount Gerizim where the Samaritans celebrate Abraham's sacrifice of Isaac
Jaffa (Joppa) where St Peter raised Tabitha and saw the unclean foods and from where the body of St James was taken to Compostela in Spain
Arimathea tomb of St Joseph of Arimathea
Joseph's pit (Muslim tradition)
St Jonas where Jonah was set ashore by the whale
Abbey of St Habakkuk plain from which Habakkuk was carried to Babylon by an angel
Lod (Lydda) tomb of St George and where St Peter cured Aeneas
Ramla confused with Ramah, birthplace of Samuel
Emmaus (Greek tradition)
Gibeon
Jericho
Jerusalem
Mount Nebo where Moses died in sight of the promised land
Bethlehem
Ashkelon (Ascalon)
Monastery of St Charitон
Tekoa plain from which Habakkuk was carried to Babylon by an angel
Tomb of Amos
Bethgibelin
Oak of Mamre and Abraham's spring
Hebron tombs of the Patriarchs, Adam and Joseph
Desert of St John
Gaza
Tomb of Lot
En-gedi
Carmel where David sought victuals for his men
Mount Sinai
34° 30
35
35°30'
36
31°30'

Fig. 17.4. Distribution map of pilgrim badges found, pilgrimage sites and roads during the 12th century (based on Riley-Smith 1991: 43).

Discussion

A tale of two species

Reviewing the finds, we can see that two species of shells were used: *P. maximus* and *P. jacobaeus*. The scientific name *P. jacobaeus* (St James' shell) was given by Linné to a bivalve living in the Mediterranean, while the true shell, *i.e*. the one we associate with the Santiago de Compostela pilgrimage, belongs to the one that Linné named *P. maximus*, which is found on the Atlantic coast (Almazán 1996: 132). As noted before, the pilgrim bought the badge at his destination, Santiago de Compostela. Since Santiago de Compostela is near the Atlantic coast we would expect to find the Atlantic species *P. maximus*. However, ten of the pilgrim shells found in Israel belong to the Mediterranean species *P. jacobaeus*.

One possible explanation is that the *P. jacobaeus* shells were counterfeit shells. Taking into account the enormous demand generated by mass pilgrimage, it becomes easier to appreciate that the sale of pilgrim badges was a source of substantial revenue, in which many hoped to share (Bell and Dale 2011: 602). By the thirteenth century the badge trade had grown so much that the Archbishop of Compostela tried to gain control of it and, in doing so, clashed with the *concheiros* (who produced the shell badges), who had formed their own guild. Eventually the *concheiros*, with 100 licensed stallholders, were left in charge of the badge trade in return for the payment of annual rents to the church authorities (Cohen 1976: 197; Spencer 1998: 245–247). Santiago de Compostela also suffered from illegitimate competition in the badge trade. Counterfeit scallops were sold to pilgrims all along the route to Santiago de Compostela. A long series of papal bullas forbidding this abuse proved useless. However, the *concheiros* guild was strong enough to prevent any forgeries within the town of Santiago de Compostela (Cohen 1976: 197). It is possible that the pilgrim badges made from *P. jacobaeus* are evidence of this illegitimate trade along the southern route to Santiago de Compostela.

Who were these pilgrims? Identity profile

Pilgrimage is a liminal experience, which anthropologist describe as one that takes us outside our customary routines and identities. In the liminal state, there is time to reflect upon deep and universal values. Bonding with others undergoing the same experience may cut across social boundaries and create a "communal" identity (Ashley and Deegan 2009: 10, Slavin 2003: 1–2, 17). But, how do we define identity?

According to the Encyclopedia of Ideas (Gurevitz and Arav 2012: 384–385) *identity* is a key term in psychology and cultural studies. Identity is created when groups or individuals define the boundaries of their self-understanding and are willing to defend their beliefs. In the European history of ideas, the notion of the sameness of the self has foundational qualities, as described in Descartes's *Meditationes*. In contemporary texts on identity, the concept seems not to exist in the singular. Whereas it was once defined by sameness and unity, both qualities have given way to difference and plurality. Is there such a thing as "communal" identity of pilgrims? I will not attempt to answer this question in the paper. Instead, I will carefully illustrate the traits that the pilgrims, who owned the scallop badges, shared.

All of these pilgrims participated in at least two major pilgrimage journeys: one to Santiago de Compostela and the other to the Holy Land. Because of that, I refer to them as "serial pilgrims", *i.e*. pilgrims who were not content with one major pilgrimage and wished to experience one more. Pilgrim badges signified much for the bearer. A pilgrim kept the badge with him all his life and was also buried with it. Most of the pilgrim badges from northern Europe were found in graves (Almazán 1996: 132).

Due to the miracle-working ability attributed to pilgrim artifacts/souvenirs, they were also used during medieval times in magic and medicine. In some cases pilgrims donated pilgrim souvenirs to their local church, where they were kept ready in case the need arose for a cure for the sick or dying. Other magic-making abilities are apparent in the archaeological record in the discovery of pilgrim artifacts in foundation deposits (Garcia 2005: 3).

In England and Europe many pilgrim badges made from metal were found in the bottom of rivers – apparently they were thrown there as part of the ritual of reintegration into normal society and as thanks for a safe return (Garcia 2005: 4, 9). One of the pilgrim badges from Jerusalem was found in a Christian grave (Johns 1950: 162), and another in a monastery (Wadi Siah), showing similar contexts as in Europe, but the rest were mostly found in accumulations and not *in situ*. However, the presence of these pilgrim badges in the Holy Land might indicate that their owners died during pilgrimage. Death was actually common among pilgrims. It was reported that at the Hospital of St John in Jerusalem around 50 pilgrims died every day (Bell and Dale 2011: 620).

Estimations of medieval pilgrim numbers to Santiago de Compostela vary from half a million to two million a year (Stopford 1994:59), each with his individual reason for going on a pilgrimage. Common motivations for making a pilgrimage were (and still are) salvation, vows made in sickness or danger, forgiveness for past or future sins, tourism, or simply the desire to escape unpleasant companionship at home. For some individuals during the Medieval period, motivation for pilgrimage originated in an expectation of Judgment Day: the fear of eternal damnation after death, disgrace before God, and a deep sorrow for salvation of the soul (Nemes 2002: 32). Other pilgrims were sentenced criminals sent by court to perform a "penitential pilgrimage" as punishment (Ashley and Deegan 2009: 58–62). Given the far distances and dangers of such travel, it appears that only very religious or very adventurous people would go on more than one pilgrimage.

The main difficulty faced by prospective pilgrims to distant shrines was the expense. According to Bell and Dale (2011: 617–620), it has been estimated that for a European pilgrim a round-trip journey to Jerusalem might cost around 200 ducats, more than a full year's income. It is estimated that travel costs accounted for half of this expense. In addition to travel, there were food and lodging expenses, medication, footwear, the cost of offerings, and the purchase of pilgrimage badges. On the other hand, penurious or mendicant pilgrims taking the land route to Santiago de Compostela might hope to find free lodging and sustenance at monasteries and hospitals along the route.

Throughout the Medieval period the Church was obliged to provide support for poorer pilgrims, to care for those who fell sick, and to bury those who died on pilgrimage. Hospitality to pilgrims was an essential monastic obligation, but accommodation and sustenance had to be limited so it did not become an open-ended invitation to common vagrants. The financial costs of pilgrimage could be met in a number of ways. Some guilds were prepared to sponsor individual members who went on pilgrimage; financial help might also be sought from a local monastery; and pilgrimage might be combined with commercial activity along the route. It is important to note that the document pilgrims received on completion of their journey to Santiago de Compostela granted trading rights along the Camino that might be exploited on the return journey. Finally, pilgrims might find help to finance the journey by obtaining money from those who wished to have prayers said for them at various shrines and holy sites. Prawer (1975: 204–217) describes in detail the procedure, law and cost of shipping a pilgrim to the Holy Land from the moment the pilgrim reached a European port till his ship anchored in

Acre. The pilgrimage to Santiago de Compostela could have been made basically without any financial resources, but a pilgrimage to the Holy Land needed some funds. As a result, serial pilgrims must have had some income or social influence that allowed them to raise the money needed for such travel.

While women would frequently visit local shrines, they were understandably much less inclined to go on long-haul pilgrimages. One of the exceptions, Marjery Kempe, recounts some of the difficulties encountered while travelling to distant shrines: on occasion she felt obliged to pay a male pilgrim to accompany her. Such a companion insured protection. There is also evidence that some of the major shrines discriminated against women when it came to access to holy relics. However, it seems that women were just as likely as men to leave testamentary bequests for others to go on pilgrimage on their behalf (Bell and Dale 2011: 622). There is no way of knowing whether the pilgrims who owned the scallop badges were male or female, although it is more likely that most of them were probably men.

Conclusions

The major international shrines – Rome, Jerusalem, and Santiago de Compostela – were in direct competition with each other because individuals going on a long-haul pilgrimage would typically have to choose which shrine they would visit. Though some pilgrims, like Marjery Kempe, visited all three locations (Bell and Dale 2011: 612–613) and Felix Fabri visited the Holy Land twice (Schiller 1996: 207).

The archaeological evidence for pilgrims who participated in at least two major pilgrimage journeys, one to Santiago de Compostela and the other to the Holy Land, was discussed in this paper along with the attempt to outline the similarities between them. These pilgrims were motivated by strong religious feelings or were adventurous in character, and had some financial support. Some of these travellers died during their pilgrimage to the Holy Land, as evidenced by the pilgrim artifacts left behind. In addition, the presence of shell badges made from the Mediterranean species *P. jacobaeus* might be the archaeological evidence for the selling of counterfeit pilgrim badges.

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